

# ANNUAL REVIEW OF PSYCHOLOGY

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VOLUME 7

1956

ANNUAL REVIEWS, INC.

STANFORD, CALIFORNIA, U.S.A.

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150.08  
AG 15  
v. 7  
1956

ANNUAL REVIEWS, INC.  
STANFORD, CALIFORNIA, U.S.A.

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FOREIGN AGENCIES

H. K. Lewis & Company, Limited  
136 Gower Street  
London, W.C. 1

Maruzen Company, Limited  
6, Tori-Nichome Nihonbashi  
Tokyo

PRINTED AND BOUND IN THE UNITED STATES OF AMERICA BY  
GEORGE BANTA PUBLISHING COMPANY



## PREFACE

The publication schedule of the *Annual Review of Psychology* is so arranged that the Editorial Committee of any one year has the task of selecting the chapter authors for the volume to be issued two years later. This means that the selection committee for the current volume was the Editorial Committee of two years ago: J. E. Anderson, N. D. Cameron, J. G. Darley, C. T. Morgan, and R. L. Thorndike. The Editor at this earlier date was the late C. P. Stone and the Associate Editor, D. W. Taylor who was completing his term of office. Thus, credit should be given these men for the personnel of Volume 7.

The content arrangement of Volume 6 has, in general, been followed in Volume 7. There are a few changes, however. The chapter on "Individual Differences" has been omitted but will reappear in Volume 8. A chapter on "Chemical Senses" replaces one on "Somesthesia and the Chemical Senses." The special topic of "Problem Solving" which had been treated in Volumes 1 and 6 is replaced in Volume 7 by the special topic of "Gerontology," a topic which was covered once before in Volume 2. As a result of the illness of Dr. Rosenblith the chapter he was to have prepared on Audition does not appear in this Volume.

In the Preface to Volume 6 the Editorial Committee expressed its wish "to disseminate the fruits of research in psychology and to promote collaboration among scholars of all nations. . . ." In keeping with this aim an effort has already been made to secure a manuscript on "Current Psychology in the U.S.S.R.," and space was reserved for a section on this topic. While success has so far not been achieved, the attempt to obtain this chapter is being continued for future publication.

Each year the chapter authors are asked to comment on how to make the *Annual Review* better serve its purposes. Their statements are of considerable worth to the Editorial Committee which has almost no other channel of contact with the psychological public except through the letters it receives from a very few readers and from the words of the volume's reviewers. Hence, the Committee would welcome the considered opinions of many more of the *Review's* readers.

January 1, 1955 saw the retirement of John G. Darley from the Editorial Committee and his replacement by John M. Butler who will serve for the next five years. Quinn McNemar has consented to remain as Associate Editor on a term to run through 1958. And, happily, Mrs. Lillian Rutherford continues to serve as Editorial Assistant, and Miss Robbie Bass has again compiled the subject index.

The Editorial Committee takes this opportunity to express its deep appreciation of the services of the late Calvin Perry Stone. As the first Editor and Chairman of the Editorial Committee, Dr. Stone had primary responsi-

bility for the form and content of the *Annual Review of Psychology*. In large part its favorable reception by psychologists as a successful way of collating scientific research is to be traced to his leadership. From the inception of the *Annual Review* he gave unstintingly of his time and energy. The quality of his thinking, his friendly relations, and his deep interest in the furtherance of science are missed by those who were so fortunate as to serve on the Editorial Committee with him. When he resigned as Editor a few weeks before his death, it was hoped by the Committee and the present Editor that he would continue his association with the Review on an informal basis. But this was not to be.

J.E.A.	Q.M.
J.M.B.	C.T.M.
N.D.C.	R.L.T.
P.R.F.	

## ERRATA

### Volume 5

page 246, reference 60: *for* Animal *read* Annual

### Volume 6

page 456, line 43: *for* mixed *read* all-negative

page 457, line 42: *for* all-negative *read* mixed

page 476, line 11: *insert* They have also developed a second and more elaborate model.

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VOLUME 8 (1957)

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## LEARNING<sup>1,2</sup>

By W. K. ESTES

*Indiana University, Bloomington, Indiana*

It can conservatively be estimated that upwards of 1500 books and articles on learning have appeared during the seven-year period covered by these *Reviews*. What is more, the rate curve shows no sign of reaching an asymptote. Comparing a current sampling of two major journals with the comparable one reported by Melton (107) in the first *Annual Review*, I find that the outputs of experimental and theoretical articles on learning have increased by more than 20 and 75 per cent, respectively, over this period. The accumulating mountain of material represents the honest toil of an array of investigators, ranging from the most blasé drum turners to misty-eyed interdisciplinary enthusiasts, working with a population of Ss which spans the phylogenetic scale. There must be much good metal here, but how much can ever be extracted and put to use in teaching, practical application, or the direction of research? Of one fact we can be sure. Many, perhaps the majority, of the studies will soon be forgotten by all but their authors. The findings which survive will be those which are organized around laws, principles, or concepts of some generality, in short, those which lead to theory construction.

Since the continuing barrage of research findings is inevitably filtered, interpreted, and applied in terms of current theories, we can expect to improve our picture of what is going on in the study of learning by organizing a survey in terms of theoretical developments. In view of these considerations, I have tried to select for review those contributions which best exemplify the major contemporary trends in the development of learning theory and its interplay with empirical research. Whether others will see the same trends can only be decided by experiment.

### THEORIES AND MODELS

The strikingly accelerated output of theoretical papers reflects a collapse of the virtual monopoly on theoretical publication by a few systematic moguls. Theory is falling into the hands of the common experimenter. One concomitant of this trend, perhaps not entirely coincidental, is that the bulk of research on learning is becoming progressively more technical and the

<sup>1</sup> This review covers the period from May 1, 1954, to May 1, 1955. Preparation of the review was facilitated by the author's tenure as a faculty research fellow of the Social Science Research Council.

<sup>2</sup> The following abbreviations and symbols are used in this chapter: CR (conditioned response); CS (conditioned stimulus);  $sE_R$  (excitatory potential);  $I_R$  (reactive inhibition);  $sI_R$  (conditioned inhibition); GSR (galvanic skin response); Ss (subjects); S-R (stimulus-response); UR (unconditioned response); US (unconditioned stimulus).

theories more formal and quantitative. To reassure those [e.g., Maier (102)] who deplore these developments in their apprehension lest the science of learning become isolated from the world outside the laboratory, I hasten to add that the year's literature reveals an ample supply of antidotes to narrowness and insularity. The tendencies toward intensive experimental analysis and quantification in the central areas of the field are complemented by more peripheral interactions with communication theory, comparative psychology and its new cousin ethology, perceptual research, social science theories, clinical psychology, and human engineering. This fraternization will surely provide continuing sources of new concepts, new problems, and new perspectives on old problems.

In this section we shall review current attempts to construct theories at a somewhat abstract and general level. Other theoretical developments, e.g., those involving primarily the furtherance of more specifically problem-oriented theories or hypotheses and attempts to bridge the conceptual gap between related areas, will be discussed in other sections.

*Hull's system.*—The pervasiveness of Hull's influence on modern behavior theory is beyond argument, but the precise nature of this influence is clearly going to be a favorite topic of discussion for some time to come. The particular terms and assumptions of Hull's system (76, 77, 78) will doubtless vary enormously in longevity. Some concepts, e.g., stimulus trace, antedating goal reaction, habit strength, perhaps reactive inhibition, have grown in such a direct and natural manner out of experimental developments that they have been rapidly absorbed into common usage by investigators of varying theoretical persuasions. These terms will probably represent relatively permanent additions to our theoretical vocabulary even though, at a technical level, their definitions may gradually change beyond recognition. On the other hand, such concepts as stimulus intensity dynamism, the general drive factor (D), conditioned inhibition, and the drive-reduction hypothesis were not so closely dictated by factual considerations and remain highly controversial; much current research is directed toward clarifying the issues associated with these.

At a more global level Hull offered, in admittedly preliminary form, a master theory from which he expected the major phenomena of mammalian behavior to be ultimately derivable as theorems. Although the superstructure is impressive, searching examinations of the foundations [see, e.g., Koch (92); Seward (144)] reveal such grave weaknesses both in material and in construction that the theory is unlikely to last long in anything like its present form. Attempts at remodeling are to be expected, indeed are in progress, but the trend seems to be away from trying to maintain a comprehensive, unitary system, and in the direction of fragmentation into a second generation of more limited theories associated with such empirical areas as classical conditioning, discrimination learning, human motor behavior, and serial phenomena.

The task of overhauling the mathematical portion of Hull's system has



been undertaken primarily by Spence. As part of his contribution to the rapprochement of learning theory and clinical research in the Kentucky symposium (158), Spence indicates how the relations between excitatory potential and the dependent variables, response probability, latency, and responses to extinction may be derived from the more primitive assumptions of Hull's *Principles of Behavior* (76). This treatment, if followed up systematically, can reduce the number of independent postulates and improve the internal consistency of the set. In another paper (157) Spence utilizes a probability argument to derive the relations of response speed and latency to the intervening variables of Hull's system and to the independent variable  $N$ , number of reinforcements. This development brings the response model of the Hullian system closer to that of the newer statistical learning theories, a trend which should be expected to continue as mathematical workmanship improves and excess assumptions are weeded out on both sides.

*Guthrie, Lewin, Skinner, Tolman.*—The systems associated with these men have all been critically analyzed by the Dartmouth group (41), and all have been implicated, in either a motivational or a directive role, in researches published during the year. Since, however, there has been no new theory construction reported in relation to any of these systems, it will be convenient to incorporate the relevant studies into the later, topical sections of this review.

*Statistical learning theories.*—This label subsumes a number of theoretical developments which share the viewpoint and terminology of  $S$ - $R$  reinforcement theory in many respects, but differ in certain matters of methodological emphasis. Theorists of this persuasion are rather more optimistic than Skinner (151) about present possibilities of making progress toward quantitative behavioral laws of some generality and predictive power. On the other hand they are content with slower and more painstaking progress than that envisaged in Hull's quantification program (77, 78), placing more emphasis on relationships among observables and less on the postulation of hypothetical constructs. Probability of responding is taken as the principal theoretical dependent variable and related directly to characteristics of observable independent variables, bypassing the level of Hull's  $sE_R$  (excitatory potential). Generality is sought via the formulation of abstract, usually mathematical, laws (models) which may be interpreted by means of similar rules of correspondence (operational definitions, coordinating definitions) in a variety of particular situations.

Following a period of concentration upon classical and instrumental conditioning, attention has turned recently to simple forms of human learning. A previously reported (45) treatment of the Humphreys-type guessing experiment has been extended by the writer (43) to two choice situations in which probability of reinforcement ("right" or "wrong") is contingent upon the  $S$ 's response, i.e., to experimental arrangements which parallel the instrumental rather than the classical paradigm; apparently in the latter situation as well as the former, the forms and asymptotes of learning curves

under random reinforcement can be predicted *a priori* with considerable accuracy.

Detambel (32) has attempted to extend both treatments to experiments in which more than two alternative response classes are available to the S. In the "classical" case, Detambel arrives at functions, identical to those reported previously by Neimark (114) and the writer (42), which are nicely confirmed by his data. In the "instrumental" case, Detambel's (and Neimark's) results are not so promising. The data cannot be described by a straightforward generalization of the model which was adequate for the two alternative situation, and attempts to improve the model run into painful complications at the mathematical level.

A more elaborate attempt to develop appropriate mathematical machinery for handling the multiple choice problem is reported by Bush, Mosteller, & Thompson (17). Their results will be of great interest to those engaged in theory construction in this area, but effective empirical applications may have to wait upon further experimental analysis of the multiple choice problem.

Relatively direct experimental tests have been forthcoming for a number of basic assumptions of the stimulus model developed by Estes & Burke (44). Under ordinary conditions, the stimulus elements assumed to be sampled by the organism during a series of learning trials are inaccessible to direct observation or manipulation; however, Schoeffler (143) has provided the experimental analogue of a population of stimulus elements by means of a panel of independently manipulable signal lights. His Ss were first required to discriminate between two randomly selected subsets of lights, then were tested with new combinations of panel lights, including varying proportions of the two discriminated sets and in some cases other lights which had not been presented previously. Using a relatively large number of Ss and extensive controls, Schoeffler obtained the most clear cut evidence yet available in support of the assumption that response probability in a given situation is directly related to the proportion of conditioned cues.

A similar technique for manipulating stimulus populations was employed by Burke, Estes & Hellyer (15) in testing theoretical assumptions concerning stimulus variability. Rate of learning was found to be directly related to rate of stimulus sampling while asymptotes were independent of this variable, both findings being in accordance with theoretical expectation. Voeks (176), working with eyelid conditioning in human Ss, also found a direct relation between rate of learning and stability of the stimulating situation; Voeks interprets her findings as confirming deductions from her formalization (175) of Guthrie's (67) ideas.

The fact that human Ss in the guessing situation do not maximize successes has bothered a number of people, most recently Flood (51) who tries to save "rationality" by hypothesizing that the results usually obtained depend on the S's having incomplete information about the situation. If the S is convinced of "stationarity," i.e., constancy of the probabilities of

reinforcing events, he should, Flood hypothesizes, go over to the strategy dictated by game theory, namely, 100 per cent selection of the most frequently reinforced response. The problem appears to be one which will repay experimental study.

A mathematical model for two-choice discrimination learning has been formulated by Restle (130). The stimulating situation is conceptualized as a population of cues which is sampled by the organism on successive trials. Lawrence's distinction between relevant and irrelevant cues (95) is adopted, and it is assumed that on any trial the relevant cues (cues correlated with reward) sampled are "identified" (conditioned to the correct response) while the irrelevant cues sampled are "adapted" (conditioned neither to correct nor to incorrect responses). Theoretical functions are derived which describe the data of several experiments on transfer effects in discrimination learning of both rats and human Ss.

A critical problem for Restle's model, as for all theories of discrimination learning, is that of the effects of stimulus overlap. If the stimuli to be discriminated have elements in common, then according to the theory of Estes & Burke (44) there will be a limit upon the attainable accuracy of discrimination, asymptotic probability of correct responding being inversely related to proportion of common elements. Bush & Mosteller (16) have dealt with this problem by introducing a mathematical "discrimination operator" which progressively diminishes the "weight" to be attached to the common stimuli when computing response probability; Restle assumes that common cues become "adapted"; and Hull (78) has followed a similar procedure at a qualitative level. Estes & Burke's model seems to handle discrimination learning in the classical conditioning situation and other situations in which there is comparable control of stimulus and response variables, but does not seem adequate to handle typical results in the Lashley-type experiment where virtually perfect discriminations are attained even though the stimulus patterns discriminated must have many common elements. The approaches of Bush & Mosteller, Hull, and Restle seem appropriate for the latter type of experiment, but provide no clues as to the conditions which distinguish the two types. Clarification of the problem must be a first order of business for those interested in the development of discrimination theory.

In so far as the strategies presently utilized in the development of mathematical learning theories are successful, what returns can be anticipated for the energy invested? One possible dividend is a systematic theory of response measures, which would provide improved bases for inter-experimental comparisons and generalizations. A second is the pointing up of research issues, as illustrated above. A third is the development of a few general principles and concepts, e.g., those associated with the stimulus trace, stimulus sampling, conservation of response probability, which may play a part in the interpretation of a wide variety of situations and thus contribute to the rational ordering and interrelating of the more limited theories now flourishing in many empirical areas.

## BASIC CONCEPTUAL ISSUES

A methodological problem of continuing interest is that of whether *S-R* concepts provide an adequate descriptive framework for learning theory. It seems to be the tacit assumption of some investigators that by sufficiently ingenious experiments one should be able once and for all to determine whether the *S-R* approach or the cognitive-field approach is superior and then to concentrate on developing the winner. Consequently, much research effort has centered around a running skirmish between, on the one hand, a succession of oversimplified but relatively explicit theories of the *S-R* type, and, on the other, a succession of more wholistic formulations among whose tenets there usually appear the contradictories of contemporary *S-R* principles. The *S-R* theories are more often wrong, being more vulnerable by reason of greater specificity, but for the same reason have more to gain from interactions with research. The result of countless refutations has been to convince each generation of textbook writers that the *S-R* approach is dead and at the same time to force progressive modification and elaboration of *S-R* learning theory, which continues in ever changing guise to function as one of the principal organizing and directing forces in the study of learning.

*What is learned.*—Each theory has its own answer to the question of what is learned in a learning experiment. Kendler (88), speaking for reinforcement theory, tried to dispose of the matter once and for all by declaring the question operationally meaningless, but Campbell (22) has come to the rescue by showing that it can be given operational significance within the context of a transfer or transposition experiment. More generally, I think the question retains both interest value and empirical relevance if it is interpreted as an expression of our perennial quest for descriptions of maximal predictive power.

A simple situation for which the problem of what is learned remains unsettled after much investigation is T-maze learning by the rat. The question here is whether or not the data are best described in terms of the conditioning of left and right turning responses to choice point stimuli. One reason for continued interest in this question is the apparent belief of some investigators that a negative answer would force a cognitive, as opposed to an *S-R*, interpretation. Tolman, Ritchie & Kalish (169) in a well known experiment obtained results apparently unfavorable to *S-R* theory. They trained rats in a cross-shaped maze which had goal boxes at both ends of one arm and start boxes at both ends of the other arm, one of the stems being blocked on each trial so as to convert the cross into a T. Animals in a "response" group were always rewarded after a given turn, therefore sometimes in one goal box and sometimes in the other; those in a "place" group were always rewarded in a given goal box, therefore sometimes after a right and sometimes after a left turn. The finding of faster learning on the part of the latter group was interpreted as favoring a description in terms of "place" rather than "response" learning. Thompson & Thompson (167) criticized the experimental design on the grounds that alternation tendencies were uncontrolled, and

upon running a similar experiment with spaced trials found no significant difference between the two procedures. Galanter & Shaw (53) have in turn criticized Thompson & Thompson for providing insufficient extra maze cues to permit discrimination of "places." In their own study, Galanter & Shaw combined well spaced trials with an abundance of extra maze cues and obtained results strongly favoring the "place" procedure; an additional group showed that number of distinguishable cues available at the choice point is probably an important parameter.

The finding of more rapid learning under the "place" procedure with spaced trials seems incompatible with an *S-R* formulation which takes right and left turns as response units. The matter will not rest here of course. Those disposed to maintain an *S-R* framework can do so by redefining units. The learning could, for example, be described in terms of the conditioning of approach and withdrawal responses to cues associated with the goal alleys. Then the application of any variant of reinforcement theory would lead to correct predictions concerning the "place" versus "response" comparison.

*Continuity in discrimination learning.*—In a general way, "continuity" refers to the set of assumptions common to *S-R* learning theories: (a) that a discrimination between two complex stimuli develops via cumulative effects of reinforcement and nonreinforcement, (b) that these variables produce a progressively increasing difference in the tendencies for a given response to be evoked by the two stimuli, and (c) that once a response has been conditioned to a stimulus, there is an increased tendency for this stimulus or any of its components to evoke the response if tested in a new situation. The overall pattern of experimental results is not very surprising. The simplest designs almost always yield results in accord with the *S-R* analysis, while more complex designs often yield results difficult to interpret in these terms.

Recent experiments by Moltz (111), Bruner, Matter & Papanek (13), and Mahut (101) offer no great difficulties of interpretation. The first of these studies demonstrated greater transfer of the effects of an indirect extinction procedure from one maze to another when the starting alleys of the two were the same than when they were different. The second showed that rats' learning of an alternation problem is facilitated by previous training on a black-white discrimination during which the positive stimulus appears alternately on the left and right sides of the choice point; these investigators propose redefining the continuity-noncontinuity issue in terms of breadth of learning. The third study demonstrated significant transfer of response to components of the positive stimulus in a Lashley situation, and also differential latencies to the positive and negative stimuli during a period of consistent position responding.

A series of studies with monkeys by Warren (180, 181, 182) introduces the factor of previous learning history and leads to the conclusion that available *S-R* theories of discrimination are not adequate to predict fully the performance of test-wise primates. What is worse, Lawrence & Mason (99) have found evidence that the *S-R* theories are not adequate even to predict fully

the performance of test-wise rats. It can conservatively be stated that the area of inter-problem improvement in discrimination learning is one in which the experimenter is for the moment comfortably ahead of the theorist. And just to multiply the latter's problems, this year has seen a number of record performances by discrimination learners. Under the evidently favorable conditions provided by Fields' (48) multiple discrimination apparatus, rats have been able to learn and retain simultaneously as many as 20 discriminations between different pairs of visual stimuli. Dufort, Guttman & Kimble (36) report unerring one-trial reversal of a positional discrimination by rats after only seven to eight training series. And not to be outdone, monkeys, under the tutelage of Riopelle & Copelan (132), learned to reverse discriminations whenever the color of the tray bearing the stimulus objects was changed.

The more analytical studies of learning sets [see, especially, Riopelle (131); Warren (182)] show that positive and negative transfer effects of the type predictable from "continuity" assumptions are indeed present, but that they undergo progressive modification in the course of a long series of problems.

*Relational learning.*—The problem of relational versus S-R learning involves the same issues as that of what is learned. Within any single discrimination learning series, several alternative formulations are equally descriptive. Consider, for example, a three-door Lashley apparatus with stimulus cards bearing small, intermediate, or large figures (S, M, and L). If a series of discrimination trials is given with M positive and the other two figures negative, the learning could be described in several alternative ways: (a) the jumping response becomes conditioned to M and opposed responses [or inhibitory potential, in Spence's formulation (155)] to S and L; (b) the response of jumping toward the left becomes conditioned to the pattern MSL, the response of jumping toward the right becomes conditioned to the pattern SLM, and so on; (c) the animal responds directly to relationships among sets of stimuli and learns to jump toward the intermediate figure irrespective of the absolute sizes of the set presented. These formulations can be distinguished operationally by testing with new stimuli which have not been presented during training, i.e., testing for transposition. Gonzalez, Gentry & Bitterman (57) trained chimpanzees to select the intermediate member of a set of three stimuli which differed with respect to size; on tests with new sets of stimuli, they obtained significant transposition, but also evidence of some preference for the absolute stimuli which had been positive during training. They argue that the transposition obtained constitutes conclusive evidence against a component formulation of type (a). Conclusiveness is an ephemeral commodity in this business, but it does appear that the intermediate stimulus problem cannot be handled in all cases by Spence's unaided gradients. Results of recent experiments concerned with the relative difficulty of simultaneous versus successive stimulus presentation [Calvin & Seibel (20); MacCaslin (100); Wodinsky, Varley & Bitterman (189)] also are interpreted as raising difficulties for component formulations, but the relevance of these studies has not been cogently demonstrated.



A new and ingenious technique for studying relational learning has been developed by Lawrence & DeRivera (98). They utilized a jumping stand with two windows, both of which always bore similar cards on any given trial. Different shades of gray appeared on the upper and lower halves of each card; seven shades were used in all, and these may be identified by the numbers from 1 to 7 running from lightest to darkest. During training, the lower halves of the cards were always number 4; if the upper half was lighter, reinforcement was available on the left, if the upper half was darker, reinforcement was on the right. Then on test trials, new combinations could be given, e.g., 4/1, 4/6, 6/2, for which relational and component formulations would yield different predictions. On the whole, the results proved more favorable to a relational than to a component description, so at a descriptive level we can conclude that learning may involve correlations between response tendencies and relational aspects of the stimulating situation.

The alternative theoretical strategies available to us at this point are either to accept relational responding as an unanalyzable characteristic of behavior and attempt to develop a theory of discrimination learning which includes this as a basic assumption, or to continue to seek a theory which will yield relational transposition as a theorem. The advantage of the former course is that, for the moment at least, more facts could be accounted for; the disadvantage is that it would involve a qualitative discontinuity between phenomena of simple discrimination, transfer, and psychophysics on the one hand and more complex phenomena, such as those observed by Lawrence & DeRivera, on the other. Discontinuity cannot be ruled out, but its presence is sufficiently annoying to the more analytically minded investigator so that we can safely predict continued attempts to eliminate it.

#### REINFORCEMENT AND EXTINCTION

*Theory of reinforcement.*—The fact that the diverse experimental operations subsumed under the concept of reinforcement, or reward, have similar effects upon the course of learning has been a source of satisfaction to some learning theorists, but merely a perpetual irritant to others. At a descriptive level, it has been possible by taking certain of these effects as the defining properties of the class of reinforcing operations, to develop, largely by means of systematic experimental analyses of a few representative situations, the relatively well-validated body of laws and concepts now generally known as reinforcement theory. This branch of learning theory has been concerned primarily with the determination of functional relationships between measures of response tendency and such independent variables as delay, magnitude, frequency, and temporal distribution of reinforcements.

At a more speculative level, the question inevitably arises whether different methods of reinforcement do not have in common some mechanism or process which could be defined independently of its effects upon behavior during learning. The most conspicuous favorite-son candidate for some time has been drive reduction. The difficulty that drives can be given independent definition in only a very few experimental situations is apparently out-

weighed by the fact that nearly all studies of animal learning are conducted in these few situations. Providing any kind of decisive test of the drive reduction hypothesis has proved a tricky business; but interest in the problem continues.

A crucial test of drive reduction versus contiguity theory has been attempted by Zeaman & Wegner (194), using human heart rate conditioning as the experimental vehicle. Noting that in earlier studies the conditioned heart response sometimes did and sometimes did not agree in form with the unconditioned response, Zeaman, Deane & Wegner (192) proceeded to make a careful analysis of the form of the heart response to shock both before and during conditioning. Then Zeaman & Wegner were in a position to compare Ss for whom the heart was accelerating at the time of shock termination with Ss for whom it was decelerating. They found that in the former case the conditioned response took the form of an acceleration, in the latter a deceleration. On the assumption that onset and offset of shock correspond to initiation and reduction of a drive, these findings are interpreted as supporting the drive reduction hypothesis. Whether they refute contiguity theory is debatable. If I read Guthrie (67) correctly, his contiguity principle also would predict that the last response evoked on each trial should be selectively strengthened. The Zeaman & Wegner experiment may turn out to be more important for general conditioning theory than for the drive reduction versus contiguity issue. The well known fact that the form of the CR frequently differs from that of the UR has long been a source of joy and inspiration to critics of conditioning theory. Their lot will be a harder one if it turns out that the formal relationship of CR and UR depends in a simple way upon the nature of the behavior at the time of US termination.

Sheffield, Roby & Campbell (145) have attempted to test the drive reduction hypothesis by reinforcing runway behavior of hungry rats with solutions containing either a nutritive substance, dextrose, which initially evokes little more consummatory behavior than plain water, or a nonnutritive substance, saccharine, which in proper concentration evokes strong consummatory behavior, or a combination of both, which evokes still stronger consummatory behavior. They found a direct relation between strength of consummatory behavior and speed of running. On the basis of this relation together with a somewhat indirect attempt to partial out the contributions of gustatory and nutritive factors, they argue that the consummatory response rather than drive reduction is the critical aspect of food reinforcement. The important role demonstrated for consummatory responding is not to be denied; but the claim that the nutritive value of the solution is noncontributory to reinforcing effects will be convincing only to those who accept the associated theoretical arguments. What is needed is a completely tasteless nutrient which could be added to saccharine solution in varying amounts to achieve clear-cut experimental separation of the confounded variables.

In answer to the question of why the consummatory response should play such an important role in reinforcement, Sheffield, Roby & Campbell hypoth-



esize that partial consummatory responses produce "excitement" which is then "channeled into" the running response. Assuming that the writers intend to maintain a contiguity position, the construct "excitement" appears rather as a nonpaying passenger, unless it is simply to serve as a label for a class of locomotor behaviors which become conditioned to stimulation from partial consummatory responses.

The contiguity interpretation of reinforcement has also come in for its share of testing, the most direct attempt of the year being that of Davis (27). According to Guthrie's (67) view, responses become conditioned to stimuli simply upon contiguous occurrence, but rewards facilitate learning by changing the stimulating situation immediately after evocation of a given response and therefore protecting the newly formed *S-R* association from interference. From these assumptions it follows that learning should be facilitated in a maze or runway if the animal is removed from the goal box immediately after eating. Davis compared rates of learning in a T-maze with 60 sec. confinement versus no confinement in the goal box after eating, and obtained no significant difference. Unfortunately Davis also detained the rats of his confinement group in the empty goal box 60 sec. longer than the control rats on incorrect trials. On both theoretical and empirical grounds [cf. Stanley & Rowe (162)] it would be expected that this procedure would increase the rate of error elimination, thus tending to counteract the effects expected from detention on reinforced trials.

A number of recent experiments bear upon the range of operations which may serve as reinforcers. Myers & Miller (113) found that rats would learn to press a bar which opened a door and permitted access to the other compartment of a shuttle box even when the animals were apparently thoroughly satiated and received no obvious reinforcement of any kind in the apparatus. A possibly related finding is that of Kagan & Berkun (85) whose rats learned to press a bar which removed the brake on a running wheel. In each of these studies the authors prefer to interpret their findings in terms of reduction of exploratory or activity drives. And in each case a contiguity interpretation seems about equally plausible. The former type of interpretation has the disadvantage of requiring a new drive for each new situation; the latter is apparently parsimonious, but at present not sufficiently explicit to be applied without ambiguity.

Delgado, Roberts & Miller (29) found that a "fear-like reaction" induced in cats by electrical stimulation of the brain could be conditioned to stimulation associated with a shuttle-box compartment, following which the animal learned to escape from the compartment without further stimulation.

Probably the year's most talked-of experiment is that of Olds & Milner (118) who report "reinforcement" of a bar pressing response in the rat by electrical stimulation of the septal area of the brain. The chief question at issue is whether this is "really" reinforcement. Translated into more operational terms, the question would seem to be whether the phenomena observed by Olds & Milner bear the same relations to other experimental variables

as do more familiar phenomena now generally categorized as instances of reinforcement. Stimulation of the septal area following a bar pressing response by the rat leads to an increase in rate of bar pressing, but it remains to be seen whether this procedure can be used to establish a discrimination by selectively conditioning the response to a particular stimulus, whether resistance to extinction will increase in an orderly manner with number of "reinforcements," whether retention loss will follow the course characteristic of ordinary learned responses, and so on. Further analysis of this problem will certainly be awaited with interest by adherents of all branches of learning theory. Meanwhile the occurrence of a novel finding of this sort has the prophylactic effect of leading us to inquire more closely just how we identify the class of events or operations which qualify as "really" reinforcing.

Another interesting attempt to bypass some of the events usually involved in reinforcement has been reported by Coppock & Chambers (25). They confined rats in an apparatus which permitted recording of head movements and administered glucose or saline solutions intravenously whenever the animal's head moved to or remained on a given side. Relative preference for the "reinforced" side increased significantly during glucose administration. This finding is interpreted as consistent with the hypothesis that reduction of a physiological need is a sufficient condition for reinforcing a habit. Using the same type of apparatus, Coppock (24) has also demonstrated an apparent reinforcing effect of lights or clicks which have previously been associated with shocks; this result seems bizarre on common sense grounds, but the study of reinforcement is getting to the point where common sense is not a safe guide. As in the Olds & Milner situation, further analysis will be required to determine whether the lights, clicks, and intravenous injections studied by Coppock yield all of the effects characteristic of better understood reinforcing operations. Other techniques of reinforcement utilized during the year which are slightly off the beaten path include the termination of a high frequency auditory stimulus [Harrison & Tracy (70)] and incomplete sexual responses [Kagan (84)].

The population of demonstrated reinforcing operations is growing so rapidly in both size and diversity that it becomes ever more difficult to imagine some one common property which would be at least potentially definable independently of effects on behavior. The possibility forces itself on us that there may be no such property. However, failure to find one would not necessarily leave us with a typology. Perhaps integration will develop at a more abstract level than that contemplated by most contemporary theorists; this possibility is in fact one of the sources of motivation for the development of mathematical theories of learning.

*Parameters of reinforcement.*—Although many experiments in a variety of situations have been concerned with magnitude of reinforcement, little progress has been made toward any general statement as to how this variable is related to measures of learning or performance. The chief obstacle to progress seems to be the lack of any common scale of measurement. It is hardly to

be expected that relations expressed in such units as volume or weight of various food stuffs will have much generality. One line of development, well represented this year, which might yield progress toward a suitable scale of measurement is the correlation of measures obtained in learning experiments with those obtained in psychophysical experiments. Guttman (68) studied rates of bar pressing in relation to concentration of glucose or sucrose in solution. A fair correspondence was obtained between pairs of concentrations yielding equal rates of bar pressing in rats and pairs yielding judgments of equal sweetness by human Ss. Guttman concludes that the effects of reinforcing stimuli upon receptors, as ascertainable by psychophysical techniques, are closely related to their reinforcing properties. In a somewhat related experiment, Hutt (81) determined rates of bar pressing as functions of quantity and quality of food reinforcement. The substances used were a flour and milk mixture with citric acid or saccharine added. Rates of responding under periodic reinforcement exhibited orderly relations to both variables, and the results obtained with bar pressing corresponded closely to those of preference tests. In the light of these and related [see, e.g., Sheffield, Roby & Campbell (145); Young & Shuford (191)] findings, prospects are good that a variety of reinforcing variables will prove to be scalable in terms of an independent set of operations.

*Secondary reinforcement.*—It is reasonably well established that if a stimulus is presented in appropriate temporal relation to a reinforcing operation, e.g., the presentation of food, the stimulus will subsequently (a) prolong extinction if administered following each occurrence of a response, and (b) tend to strengthen a new response, i.e., one with no known history of reinforcement. Melching (106) suggests that only the latter effect should be taken as evidence for secondary reinforcing properties, since the former can be accounted for in terms of stimulus generalization decrement. Under the massed trial conditions which nearly always obtain in studies of secondary reinforcement, the stimuli which follow one response may also contribute to the stimulus complex which evokes the next, and any change in these stimuli would be expected to produce a decrement in response strength. This suggestion is timely, for Elam, Tyler & Bitterman (40) have come up with a spaced-trial experiment in which effect (a) fails to appear. Rats were given 50 per cent random reinforcement on a runway with black goal boxes on reinforced and white goal boxes on nonreinforced trials (or vice versa), then half of the animals were given extinction on the reinforced and half on the nonreinforced color. Contrary to secondary reinforcement doctrine, faster extinction occurred with the reinforced color. This finding is not especially mysterious, but it does reinforce the opinion that the secondary reinforcement principle is not ready for cavalier application.

In experiments of more conventional design, factual background continues to accumulate concerning conditions of secondary reinforcement. It has often been suspected that food has a reinforcing effect upon satiated animals; this suspicion has been confirmed by Wike & Casey (188) with two

methods of satiation. In another experiment (187) the same authors demonstrated a reinforcing effect of food for thirsty rats. Generalization of secondary reinforcement has been studied by Reid & Slivinske (129) and by Ehrenfreund (39), the former with apparently negative, the latter with positive results.

*Operant conditioning.*—Developments of methodological interest to students of operant conditioning have been reported by Hurwitz (79), Sidman (147), and Ferster (47). Hurwitz measured duration of the bar pressing response and obtained orderly curves of decline during conditioning and increase during extinction. Sidman analyzed the temporal distribution of avoidance responses in bar pressing situations with both rats and cats. Obtaining frequency distributions of inter-response times which in many cases could be described by functions derived on the assumption of random ordering, Sidman argued that temporal conditioning could not have been responsible for the avoidance learning. Ferster trained rats to press a bar for intermittent food reinforcement when a buzzer was on and to press the bar to avoid shock when the buzzer was off; records for one rat suggest no interaction between the two conditions.

A novel and interesting result on operant discrimination was reported by Smith & Hoy (153); they gave aperiodic reinforcement for bar pressing during alternate 2 min. intervals, the discriminative stimulus being present during these intervals and absent the rest of the time. Apparently over-all rate of responding remained virtually constant while development of a discrimination was reflected in a drawing apart of rates during the two types of intervals.

Principles of operant conditioning have been summarized in an engaging and readable fashion for the elementary student by Keller (87).

*Decremental phenomena.*—Those most active members of the Hullian family, the brothers inhibition, seem to be drifting into different social strata. Reactive inhibition ( $I_R$ ) has come into very wide usage as a label for any sort of temporary response decrement; going with it is the assumption, tacit or explicit, that the same underlying process or mechanism is involved in all cases. Accumulating evidence on this assumption appears to be none too favorable. At one time spontaneous alternation in rats seemed neatly accounted for in terms of  $I_R$  [Zeaman & House (193)]. But later studies [Rothkopf & Zeaman (138); Walker *et al.* (178)] have shown decisively that this phenomenon is dependent primarily upon stimulus, rather than response, variables. [Incidentally, another study by Walker *et al.* (177) seems to have disposed of Glanzer's (56) "stimulus satiation" hypothesis.] Effects of work load upon curves of conditioning and extinction have appeared to be another natural candidate for an  $I_R$  interpretation. Results obtained by Stanley & Aamodt (161) with a bar-pressing situation indicate, however, that the form of the response is modified by the work load, in which case the  $I_R$  interpretation becomes untestable. It is my guess that over an extended period the explanatory function of  $I_R$  will be taken over in one specific area

after another by concepts more closely related to experimental parameters, although  $I_R$  may remain in widespread use as a descriptive term.

Conditioned inhibition ( $sI_R$ ) remains an ostentatiously theoretical construct. And as a result of the nebulous specification of the conditions under which  $sI_R$  develops, this construct has been treated rather sternly by some recent reviewers, e.g., Underwood (170), Koch (92). Most experiments purportedly yielding measures of  $sI_R$  have not provided adequate controls for rate of learning under massed as compared with distributed conditions. Starkweather & Duncan (163) have tried to meet this criticism by matching massed and spaced trial groups for initial post-rest performance on a pursuit task. After rest, the formerly massed trial groups excelled on both massed and spaced conditions, contrary to predictions from  $sI_R$  theory as these authors view it. I am afraid, however, that there are loopholes in their case which will not escape the notice of inhibition specialists.

Denny, Frisbey & Weaver (31) gave eight groups of Ss three sessions of rotary pursuit practice, one group under each possible combination of spaced and massed trials (MMM, MSM, etc.). By assuming that all  $I_R$  dissipates within 5 min., that  $sI_R$  develops only during massed practice, and that the total difference between performance under massed and that under spaced trials is attributable to  $I_R$  plus  $sI_R$ , they seem to handle all of their data, including decremental effects, recovery, etc. It turns out that they must have fortuitously chosen intervals that satisfy all necessary assumptions.

With the flexibility permitted in applying the inhibition concepts at present, there is necessarily associated a relative insensitivity to negative findings. These concepts have been fruitful in reviving interest in certain areas of motor behavior and in suggesting possible interrelationships between these and other research areas, but the widespread compulsion to force each new set of data into line with the theory may impede progress both toward correcting the theory and toward analyzing out the functional relationships between decremental phenomena and independent variables.

The two types of inhibition were originally intended to account not only for phenomena of work decrement but also for the extinction of classically and instrumentally conditioned responses. If upon each occurrence of a response a quantity of inhibition is built up and a portion of this is conditioned to the stimulus which evokes the response, then response strength would be expected to decrease, i.e., extinguish, on a nonreinforced trial since there would be nothing to counteract the newly conditioned inhibition. The inhibition model is descriptive of extinction at a qualitative level, but it does not always fit so well at a finer level of analysis. To take one recent example, curves for extinction of an instrumental escape response reported by Edmonson & Amsel (38) show, not the gradual increase in response time expected on the assumption of cumulative inhibition, but large and abrupt increases appearing after several periods of virtual constancy.

Recent evidence from a variety of sources seems favorable to the view that extinction, at least in the instrumental case, is attributable to the learn-

ing of interfering responses, facilitated perhaps by stimulus generalization decrement or "novelty." This interpretation has been subjected to indirect tests of various sorts by several investigators during the year. Stanley & Rowe (1962) reasoned that the decremental effect of a nonreinforced runway trial should be directly related to duration of confinement in the empty goal box, the assumption being that longer intervals of confinement would permit the occurrence of more varied responses which could then become conditioned to the cues that had formerly evoked the running response. Giving 10, 30, and 50 sec. of confinement per extinction trial to different groups of rats, Stanley & Rowe found significantly more extinction decrement in the same number of trials for the animals receiving the longer confinements.

According to interference theory, a response need not be performed in order to undergo extinction. All that is essential is that the stimuli which evoked the response during acquisition should be present under conditions which lead to the learning of some incompatible response. Previous studies of "extinction without performance" have been followed up by Hurwitz (1960). After acquisition of a bar-pressing response under the usual conditions, groups of rats were given extinction either immediately, after a rest period in the home cages, or after a period in which they were permitted to explore the Skinner box with no bar available. Fewest nonreinforced bar presses occurred during extinction for the third of these groups. In an avoidance situation Page (1959) replicated an earlier finding that rats which had been prevented from making the avoidance response on early extinction trials reached a criterion of extinction more rapidly than controls; the new experiment included an additional phase in which a response opposed to the original avoidance response was given food reinforcement, and the finding that the experimental animals yielded the higher latencies in the second phase is interpreted as favoring an interference rather than a motivational interpretation of the extinction results.

*Partial reinforcement.*—Partial reinforcement, the most notorious skeleton in the closet of reinforcement theory, has reappeared in a headline role after a short tranquil period during which it seemed to be securely disposed of by the stimulus-trace, or "novelty" hypothesis. Despite conceptual differences on other points, all varieties of reinforcement theory agree that in any learning situation the strength of a habit is increased on a reinforced trial and decreased on a nonreinforced trial. From this assumption it follows that habit strength, and therefore resistance to extinction, should be directly related to percentage of reinforcement during a fixed number of trials. However, in nearly all cases, experiments have yielded exactly the opposite result (1958). The situation seemed to be saved for reinforcement theory by a simple but ingenious hypothesis suggested in somewhat different contexts by Skinner (1951) and Hull (1953) and elaborated by Sheffield (1958). According to this interpretation the stimulus complex to which the organism responds on any trial includes stimulation (including, in Hull's formulation, stimulus traces) arising from the responses and reinforcing events of preceding trials. Under



continuous reinforcement, only stimulation from reinforced trials is present during conditioning, so the shift to extinction, if trials are temporally massed, introduces new stimuli arising from nonreinforced trials, and these would be expected to decrease the strength of the conditioned response. Following a conditioning series with partial reinforcement, it is less likely that the onset of extinction will entail the introduction of stimuli which have not been present on reinforced trials. This formulation leads to the prediction of a direct relation between percentage of reinforcement and resistance to extinction after spaced trials and an inverse relation after massed trials, since only in the latter case will stimulus traces associated with reinforcement or nonreinforcement be effective at the beginning of a subsequent trial. These predictions were apparently confirmed in detail by Sheffield (146) and given further support by studies of partial reinforcement under massed conditions in a variety of situations.

A premonition of trouble ahead for the stimulus-trace hypothesis came from a study by Crum, Brown & Bitterman (26) showing that with delay rather than omission of reinforcement on a portion of conditioning trials, resistance to extinction was increased over that associated with 100 per cent immediate reinforcement although no traces of nonreinforced trials could have been present during the conditioning series. Reopening of the issue was completed this year by Weinstock (183). Giving runway trials to rats with a 24 hr. intertrial interval, Weinstock obtained a pronounced and significant inverse relation between percentage of reinforcement and resistance to extinction. Further, Weinstock with rats and Michels (108) with monkeys found the asymptote of response time during acquisition to be essentially constant over a wide range of percentages of reinforcement. It seems clear that the decremental effect of a nonreinforced trial decreases as a function of the number of preceding nonreinforcements during a partial series, even when trials are widely spaced.

An observation reported by Weinstock suggests a possible interpretation in terms of contiguity-interference principles. The observation is that on early nonreinforced trials the rats display agitated behavior which tends gradually to disappear with repetition of nonreinforcement. According to interference theory, the decremental effect of a nonreinforced trial should be expected to depend on the promptness and vigor of locomotor behaviors evoked by nonreinforcement. If upon repeated exposure to nonreinforcement, these competing behaviors tend to drop out ("habituate"), then the decremental effect of nonreinforcement should tend to disappear also. Similar reasoning has been employed by Lauer & Estes (94) in analyzing the effects of repeated conditioning and extinction series. Since repeated conditioning-extinction is simply a special case of partial reinforcement, the interpretation just presented leads to the prediction (confirmed by Lauer & Estes' data) that extinctions should become progressively slower if trials are distributed. The finding of Grosslight, Hall & Scott (66) that reversal of a discrimination is slower after partial than after continuous reinforcement and the negative

result obtained by Scharlock (142) on "nonresponse extinction" of a T-maze habit after noncorrection training may be amenable to the same type of analysis.

Even if it is granted that the interference interpretation accounts for the effects of partial reinforcement at one level of analysis, the question may still be raised why the competing reactions initially evoked by nonreinforcement should tend to habituate over a series of trials. It is possible that this in turn can be handled by contiguity-interference principles, but the problem has not been dealt with either experimentally or theoretically in this year's literature.

It should be emphasized that the interference and stimulus-trace interpretations are not mutually exclusive. While the latter, taken alone, does not provide an adequate account of relationships between partial reinforcement and resistance to extinction under all circumstances, it may still play an important role in the interpretation of massed-trial and free-responding studies. In fact, the assumption that under the latter conditions the stimulus after-effects of one or more preceding trials constitute part of the effective stimulus sample on a given trial continues to gain support from a variety of independent sources. In one relevant experiment, Rothkopf (137) gave rats a series of daily runway trials, then tested them by giving two trials per day spaced 5, 15, 30, or 120 sec. apart. As anticipated on the basis of the stimulus-trace hypothesis, a decrement in strength of the running response was observed on the second trials of the test days, being greater in amount the shorter the interval, and disappearing in all cases during further training under the new conditions. Amsel & Ward (2) succeeded in training rats to go to one side of a T-maze after receiving food or water at the choice point and to the other side after nonreward at the choice point; having included control measures which should have attenuated the effectiveness of "mouth cues" following reward, the authors interpret their results in terms of "frustration" produced by nonreward. Wickens & Miles (186), using a repeated conditioning-extinction design with massed trials, obtained a progressive speed-up in extinction rate. This finding seems satisfactorily accounted for in terms of a discrimination based on stimulus traces from reinforced and nonreinforced trials.

A stimulus-trace interpretation may also account for "regression" reported by Perkins & Tilton (121). These investigators trained rats to go to one side of a T-maze with spaced trials, then to go to the other side with massed trials. After the last trial of the reversal series, the colors of the stem and end boxes were changed (this operation requiring more time than the intertrial interval obtaining during reversal); then on a test trial two-thirds of the rats reverted to the first learned side. Whether the "regression" should be attributed to the color changes or to the change in intertrial interval can only be answered by the addition of further controls.

#### DRIVE

*Drive and conditioning.*—Current usage of "drive" among the Hullians,



by all odds the prime users, has been summarized by Farber (46): a drive state is assumed to be associated with, or produced by, a given variable if either (a) termination of the variable is reinforcing, or (b) "the presence of the variable energizes or intensifies whatever reaction tendencies exist in the given situation" (46, p. 2). As Ritchie (133) has pointed out, a literal interpretation of this definition would make the concept unpleasantly circular. The intended interpretation, I should imagine, is that both of the properties (a) and (b) characterize all drives, but that since they always go together, only one need be demonstrated to identify a particular instance.

Much research activity has been devoted to attempted tests of two related assumptions, firstly, that drive reduction is a necessary condition for reinforcement (discussed above), and, secondly, that there are measurable variables manifesting property (b). The presently most popular candidate for the latter role is an individual difference variable presumably measured by score on the Taylor "anxiety" scale (166). On the assumption that "anxiety" score reflects drive level, high scorers should condition more rapidly than low scorers in the classical situation; initial tests of this prediction with eyelid conditioning were confirmatory (46, 158), but a more recent experiment [Bindra, Paterson & Strzelecki (8)] yielded negative results with salivary conditioning, so generality of the relationship is in doubt.

Whether a high "anxiety" level should be expected to improve or impair performance in more complex learning situations will depend [Farber (46); Spence (158)] on whether the initial strength of the correct response is greater than or less than that of competing incorrect responses. Several recent studies [e.g., Gordon & Berlyne (60); Spence & Beecroft (159); Spence, Farber & Taylor (160)] have yielded results interpreted by the investigators as supporting the hypothesis of the Iowa group, while at least one [Hilgard, Jones & Kaplan (72)] has been less easy to handle. It seems unlikely that any definitive solution to this problem will be forthcoming in the near future. The theoretical difficulty is that we have no unequivocal way of identifying all of the competing reaction tendencies present in a situation. Usually reactions involve movement, but on occasion "immobility" may qualify as a reaction [Farber (46, p. 3)]. This source of ambiguity will have to be cleared up before the hypotheses at issue can be subjected to experimental test with any hope of interstate agreement on the interpretation.

The last straw for the beleaguered anxiety theorists may be Grice's (65) finding that a difference between high and low "anxiety" groups of the kind routinely accepted as confirming the drive theory disappeared when subjected to a covariance analysis with an ability test score as a control variable. This is, to be sure, merely a correlational result, but it cannot be lightly disposed of on that ground since all relationships between "anxiety" score and performance in learning experiments are of similar status.

This year, as every year, there have been numerous studies of hunger and thirst drives in the rat. Most of these are concerned with testing hypotheses about drive selectivity, drive interaction, or the influence of drive on learning as distinguished from performance, and few result either in settling the-

oretical issues or in establishing new empirical relationships. Two studies reported during the year which serve at least the latter function are one by Ramond (127) which yielded a direct relation between speed of bar pressing and interval of food deprivation at two delays of reinforcement, and one by DeValois (33) which yielded an inverse relation between drive level and response variability in a two-choice situation.

Research on the subhuman primates customarily gets along without frequent calls for a general energizing factor. Exploratory and manipulative drives are, however, becoming prominent [see, e.g., Harlow (69)] as academically respectable ways of saying that the primates peer through windows and work puzzles tirelessly even when there is no reward in the offing. Finally, in the more conventional areas of research on human learning, drive continues to be left hovering in the wings along with all the other things association psychology is criticized for neglecting.

*Secondary drives.*—The concept of learned drive has found that it is not safe even in the company of friends. Myers & Miller (113) gave four groups of hungry rats 0, 10, 30, or 70 "drive acquisition" trials, i.e., reinforced runs through the door of a shuttle box, then found that when satiated all four groups learned at the same rate to press a bar which opened the shuttle box door; presumably an acquired hunger drive would have affected the rate of bar pressing. An earlier experiment of Calvin, Bicknell & Sperling (21), which had yielded apparent conditioned hunger, was repeated by Siegel & MacDonnell (149) with negative results; groups of rats that had been fed in distinctive boxes daily for 24 days, while under high versus low food deprivation, exhibited no differences in amount eaten when tested in the boxes under an intermediate drive level. Problems of control and interpretation are especially acute in this area, partly because any "drive conditioning" procedure permits the conditioning of many responses, both skeletal and visceral, which may influence behavior on test trials, either directly or through the effects of response-produced stimuli.

*Avoidance.*—Solomon & Wynne (154) have reviewed and extended their interpretation of traumatic avoidance learning in terms of "anxiety conservation" and "partial irreversibility." Dinsmoor (34), on the other hand, disapproves of all interpretations of avoidance or punishment which involve the assumption of an emotional or motivational state. His preference is to assume that noxious stimuli, e.g., shocks, have "aversive properties" which may be transferred to new stimuli by association. Then with the further assumption that escape from "aversive stimuli" is always reinforcing, avoidance and depressive effects of punishment can be accounted for.

#### STIMULUS-RESPONSE ANALYSES OF HUMAN LEARNING

As Buxton has indicated in an earlier review (19), one of the principal unifying trends in the exceedingly heterogeneous area of human learning is the extension and application of *S-R* concepts. Until very recently, the bulk of research on human learning has dealt with different measures and differ-

ent independent variables than research on animal learning. In the former case, attention has usually been confined to over-all measures of skill or achievement at a given task, e.g., amount of material recognized or recalled. In the latter, data have come to be treated largely in terms of frequencies, or other appropriate measures, associated with relatively well-defined response classes and the relationships of these measures to stimulus variables. This being the case, the natural desire to establish continuity between the theoretical formulations arising from research on animal learning and those arising from research on human learning has led to the carrying over not only of concepts but also of experimental designs and procedures from the simpler to the more complex level.

During the past year, the infiltration of human learning research by the concepts and methods of *S-R* theories has assumed the proportions of an invasion. A number of relevant studies have been mentioned above in relation to general theoretical developments; most, however, are concerned more with the identification of appropriate experimental variables and the establishment of functional relationships than with the testing of general theories.

*Reinforcement.*—A number of investigators have been concerned with the "automatic" effects of reinforcement in human learning. Sidowski (148) replicated the major findings of Greenspoon (63) on reinforcement of verbal behavior in a free responding situation. The *Ss* were instructed to give chain associations, and a specific class of verbal responses, plural nouns, was reinforced by the onset of a blinking light after each response of this class; reinforcement, so defined, led to an increase in frequency of plural nouns even when *Ss* were unable to verbalize the relationship between response and reinforcement. Lacey & Smith (93), repeating a study by Diven (35) with some modifications, obtained significant conditioning and generalization of a change in heart rate in a group of *Ss* who indicated on interview no awareness of the relationship between CS and US. Using a Thorndikean situation modified so as to appear to the *Ss* as an experiment on extrasensory perception, Postman & Adams (124) studied effects of reward and punishment ("right" and "wrong") as influenced by instructions given at the time of testing; they interpret their data as exhibiting "automatic" effects of reinforcement, but with these effects "modulated" by performance-instructions.

It is becoming clear that the behavior of human *Ss* in learning experiments may be modified in predictable ways by such operations as reinforcement or variation in stimulus conditions regardless of whether the *Ss* are aware of the purpose of the experiment, of what they are learning, or of the variables to which they are responding. This is not to minimize the importance of conditions which lead the *S* to verbalize relationships. Rather it becomes progressively more important to identify these conditions so that they can be eliminated or controlled while the roles of such variables as reinforcement are analyzed, and then can be studied in their own right when attention turns to more complex situations.

*Simple trial and error learning.*—Morin & Grant (112) have developed a procedure for scaling the difficulty of simple psychomotor tasks in terms of degree of spatial S-R correspondence; the procedure is demonstrated in a learning situation involving parallel banks of stimulus lights, response keys, and reinforcing lights, with the correlation between positions of stimuli and their "correct" responses controllable by appropriate switching arrangements. Using a rather similar situation, Noble (117) has obtained an inverse relation between number of response keys available to the S and rate at which the learning curves approach the common asymptote of 100 per cent correct responding.

*Partial reinforcement.*—Using the S's estimate of the extent of an auto-kinetic movement as the response to be learned, Kanfer (86) gave verbal reinforcement ("right") on 100, 67, 50, and 0 per cent of training trials to different groups of Ss, then tested all groups on extinction. Acquisition to a criterion required more trials but fewer reinforcements for partial as compared with 100 per cent groups; rate of extinction was directly related to percentage of reinforcement. A methodological advance in Kanfer's study is the use of a covariance design to separate the effects of number of reinforcements, total acquisition trials, and number of correct responses during acquisition upon resistance to extinction. The impossibility of simultaneously controlling these three variables has complicated the interpretation of previous studies.

Green (62) studied fixed-ratio reinforcement of a key-tapping response in a situation presented to the S as a problem in concept formation. He observed much higher rates of extinction responding following fixed ratio than following continuous reinforcement, and noted a number of striking correspondences between characteristics of the response curves generated by his Ss and those reported by Skinner (150, 151) for lower organisms.

Interest continues in the simple two-choice situation with random reinforcement. A number of studies have treated this primarily as a test situation for testing quantitative theories, but even in these cases parametric information has usually been forthcoming. In the simplest experimental design the S indicates his prediction, either orally or by operating a response key, as to which of a pair of alternative reinforcing events will occur at the termination of each trial. The course of learning has been found to be the same whether or not the Ss are required to make overt responses (e.g., key presses) to the reinforcing stimuli (15). The influence of the task defined for the S has been studied by Goodnow (58), who compared groups for which the experiment was disguised as a series of rational problems with groups for which the experiment was presented as a pay-to-play gambling situation; the same reinforcement schedules were used in both cases. The first procedure yielded results similar to those of simple prediction experiments [see also Goodnow & Postman (59)], but with the second procedure Ss tended more frequently to go over to the "pure strategy" of always choosing the more frequently reinforced response. It may be noted that in the latter situation

the S is provided with a cumulative count of his frequency of correct responding, while in the former the information available to the S is limited to the outcome of each successive trial.

*Discrimination learning and concept formation.*—A very clear cut example of extending to human discrimination learning a result previously obtained with animals is reported by Baker & Osgood (5). It had been found with rats that learning of a difficult discrimination was more rapid when the latter was approached via a series of problems of graded difficulty than when all of the practice was given on the difficult discrimination [Lawrence (96)]. Baker & Osgood trained groups of human Ss on pairs of tones differing only in frequency, using a design similar to that of Lawrence, and obtained essentially the same result. These findings seem intuitively reasonable, but I do not see [and neither, evidently, does Lawrence (97)] that they can be handled in detail by any available theory.

Again in a study of shock for right and wrong responses, results obtained by Freeburne & Schneider (52) with human Ss corresponded closely to those obtained previously by other investigators with animal Ss.

A more complex situation was studied by Kendler & Vineberg (90), who found that learning of a compound concept was influenced by transfer effects from previous training on simpler concepts in approximately the fashion anticipated on the basis of an *S-R* analysis. In a related experiment Kendler & D'Amato (89) compared reversal and nonreversal shifts in card sorting. An example of reversal shift would be sorting all red cards (regardless of other properties) into a left compartment and all blue cards into a right compartment after having learned the opposite in a preceding series; an example of nonreversal shift would be sorting cards on the basis of color in one series, then on the basis of form in the next. In agreement with an earlier study by Buss (18) reversal shift was uniformly the more rapid, and in fact yielded positive transfer in comparison with an appropriate control. The authors suggest that the results of the entire set of studies can best be explained on the hypothesis that a mediating ("symbolic") response intervenes between stimulation by the card, or other test object, and the S's observed response to it. Once these mediating responses are learned, they should facilitate learning in further problems involving the same stimulus dimensions.

Miller & Dollard (109) have emphasized the possible role of response-produced cues in mediating generalization and facilitating discrimination learning. In a recent nonexperimental paper, Goss (61) has analyzed in some detail the conditions of reinforcement under which response-produced cues would be expected to serve these functions. The only directly relevant experiment reported during the year [Robinson (136)] yielded rather negative results. These should not be taken as particularly discouraging, but they might remind us that the notion of response-produced cues is such a natural extrapolation of established concepts that application is likely to outrun experimental verification.

*Paired associate learning.*—This stronghold of associationism has been

invaded by Briggs (10) with a carefully designed study organized around S-R and conditioning concepts. Using a retroactive inhibition design and a modified free recall test for retention, Briggs obtained curves for probability of the first learned response, the second learned response, and "extra" responses during both the learning periods and the 72 hr. retention interval following interpolated learning. A related experiment by Briggs, Thompson & Brogden (12) provided a more detailed determination of these curves over the early portion of the retention interval. These data are the kind needed as a basis for detailed comparisons of verbal learning with simpler conditioning phenomena and ultimately for quantitative theorizing in this area.

*Incidental learning.*—Since it has become evident that learning can be demonstrated without "intention" regardless of how the latter is defined, attention has turned from the question of whether incidental learning occurs to analysis of the conditions responsible for differences in amount and kind of learning under incidental and intentional learning procedures. Saltzman & Atkinson (141) have varied the number of training trials prior to a recognition test in a situation camouflaged for the incidental groups as a problem in number coding. The incidental and intentional procedures yielded no differences in recognition score after the smallest amount of training, but a significant difference in favor of the intentional procedure after the largest amount of training. Taken together with previous results on effect of exposure interval [Neimark & Saltzman (115)], this finding indicates that superiority of the intentional procedure is a function of total time of exposure to the experimental material, a relationship which would be expected if the contribution of the instructions given the intentional groups is to increase the likelihood of rehearsal responses. Evidence from experiments comparing intentional and incidental procedures with materials of different association value and different test methods leads Postman and his associates (125, 126) also to conclude that this situation can most fruitfully be analyzed in terms of response habits.

*Conditioning.*—Although a number of recent studies have used conditioning simply as a technique for obtaining indirect measures of conceptual variables, e.g., anxiety, drive reduction, few have been concerned with analysis of the conditioning situation itself. One experiment of the latter sort has been reported by Moeller (110), who investigated conditioning of the GSR as a function of CS-US interval with a trace procedure. Maximal conditioning occurred at a 450 msec. interval, in agreement with results obtained by other investigators with skeletal responses. On the assumption that the GSR should have different parameters than skeletal responses, Moeller feels that his finding requires explanation and suggests that the CR is "actually" some unidentified skeletal response which in turn elicits the GSR. This interpretation cannot be ruled out on available evidence, but there seems to be no independent evidence for either of the assumptions involved, so Moeller, together with Smith (152) who has expressed the same



idea on a truly epic scale, is left in about the same position as the more numerous group of theorists who assume that only autonomically mediated responses can "actually" be conditioned. In a somewhat different line of investigation, Young (190) has added another to a long series of failures to obtain pupillary conditioning. Young's experimental technique, utilizing infrared photographic recording, should have been reasonably sensitive, although his one second CS-US interval may not be optimal.

*Application of stimulus-response concepts to learning in children.*—An increasingly popular line of research is the study of learning in young children with the same experimental designs that have provided the bases for *S-R* interpretations of animal learning. Considering the problems of replication in both areas, the results obtained in the two cases turn out to be surprisingly similar. The best controlled studies reported this year have fallen largely in the area of discrimination learning. The effect of delay of reinforcement on simultaneous and successive discrimination learning of three-to-four year old children has been studied by Perkins, Banks & Calvin (122). Using a factorial design with two values of delay and simultaneous versus successive presentation of the positive and negative stimuli, these investigators found learning to be much faster under the simultaneous conditions but could detect no significant effect of delay under either condition; they interpret their findings as supporting the theoretical views of Nissen (116) and Spence (156).

With somewhat older children (9 to 14 years) as Ss, Stevenson & Iscoe (164) tested for transposition after establishment of a size discrimination. Significant transposition appeared on the first test trial; it was positively related to extent of verbalization of stimulus relationships, but not to amount of overlearning. These investigators also report (165) significant transposition by mentally defective children in a similar experimental situation, although almost none of these children could verbalize the basis of transposition. Little evidence was forthcoming in support of the prediction from Spence's theory (155) that amount of transposition should decrease with increasing difference between the training and test stimuli.

In agreement with such animal studies as that of Denny & Dunham (30), an experiment by Cantor & Spiker (23) yielded faster discrimination learning in children with larger numbers of nonreinforced trials per block, learning being measured in terms of frequency of correct responses per block.

#### RETENTION AND TRANSFER

*Methodology.*—Students of human learning have persistently sought answers to such questions as that of how amount of material retained after a retention interval is related to speed of learning, distribution of practice, or amount of overlearning. Answers of the desired simplicity and generality have, however, remained persistently elusive, and it is becoming evident that these questions will not yield to direct attacks which from the outset ignore operational distinctions among experimental variables. In one prob-

lem area after another, apparently conflicting findings continue to accumulate without sign of resolution until the questions at issue are reformulated in terms of clearly defined experimental variables and methods of measurement.

Several papers reported during the year illustrate this motif. A particularly instructive example is Ritchie's (134) analysis of the similarity paradox. Ritchie shows that the paradox is attributable to a subtle shift in response definition which customarily occurs when one goes over from the retroaction or ABA design to the AAA design of ordinary learning. If one takes care to maintain consistently the response definition appropriate to the design of a transfer experiment, there is evidently no reason to expect anything but a monotonically increasing relationship between amount of interference between two tasks and degree of response similarity, or overlap.

Underwood (171) has attempted to account for previous failures to find any simple relationship between retention of rote material and intralist similarity. In his analysis of the situation, Underwood notes that when an S has learned a series of lists there must be several possible sources of interference at time of recall: items within the given list, items in previously learned lists, and material learned outside of the experimental situation. By utilizing measures of retention which are differentially sensitive to the first two sources, Underwood is able to bring out simple relationships which are generally in accord with expectation from an interference theory of retention.

In another paper (172) Underwood considers the perennially unsettled relation between speed of learning and amount retained. Assuming that retention is to be measured in terms of number of correct responses at recall or number of trials to relearn, Underwood criticizes previous investigators on the ground that groups of fast and slow learners compared have differed either in amount of practice (if all met the same criterion) or "amount learned" (if number of training trials were equated); in either case, performance after a retention interval would be expected to differ even if the groups compared had equal rates of forgetting. Upon analyzing his data by a method which equates response probabilities for "fast" and "slow" groups prior to the retention interval, Underwood finds no differences between the groups in response probabilities at recall. So assuming this method of measurement, the conclusion follows that forgetting is unrelated to rate of learning.

*Determinants of retention.*—Relationships between retention of verbal material and distribution of practice continue to defy any simple and comprehensive generalization. The latest in a series of studies by Underwood (173) has shown rather different results for paired-associate and serial list learning. In the former case, retention was better after distributed practice, although not significantly so. In the latter, "ability" of the S proved to be an important parameter, slow learners recalling better after massed practice and fast learners after spaced practice. So many factors are covarying here,



individual difference parameters, number of trials to a criterion, time over which learning is distributed, that no simple interpretation seems possible until the various sources of confounding have been experimentally separated.

Effects of change in context seem more regularly predictable than spacing effects. Weiss & Margolius (184) have reproduced and extended earlier findings (75) showing that in the paired-associate situation, retention is directly related to intactness of original stimulus context.

Systematic and progressive changes in the reproduction of visual figures over a period of time following exposure have often been invoked as evidence for the memory-trace construct of gestalt theory. Adherents of the gestalt view will, therefore, probably take little pleasure in Postman's (123) demonstration that these effects can be modified in predictable ways by appropriate preliminary training of the Ss. Although trace hypotheses are not thereby disproved, they are, Postman suggests, left in the position of excess baggage, since principles of associative learning appear adequate to account for the phenomena.

*Reminiscence.*—So many new concepts are introduced in the field of learning each year that it is refreshing to see one fall by the wayside occasionally. This year's victim may be the Ballard phenomenon, the obituary being written by Ammons & Irion (1). In the well known experiment of Ballard (6), curves for recall of verbal material as a function of time exhibited an unexpected rise for a day or two after learning, followed by a decline. The initial rise in performance has been suspected of being an artifact [see, e.g., Hovland (75); McGeoch & Irion (105)] since in the Ballard design, to be distinguished from that of Ward (179), all groups received a retention test immediately after the initial learning period, and further learning might have occurred during the test. Replicating Ballard's experiment with added controls, Ammons & Irion showed convincingly that the "reminiscence" disappears if all points on the curve of retention are based on independent groups of Ss.

*Transfer.*—Two independent studies have given rise to the suggestion that transfer of training may involve two phases, one motor and the other associative or discriminative. In Mandler's study (103, 104) the Ss learned to associate responses (a response being defined as a sequence of three key presses) with letters presented as stimuli; different groups learned the first problem to various degrees of overlearning, then were shifted to new problems which involved the same or different response sequences and the same or different stimuli in various combinations. Transfer of an old response to a new stimulus was found to be positive. With a new response and an old stimulus (i.e., a stimulus previously paired with a different response) transfer was slightly negative. With an old response and an old stimulus transfer was intermediate, becoming positive for the greatest amount of overlearning on the first problem. The first and third findings require, Mandler feels, a concept of response integration apparently corresponding roughly to Skinner's concept of chaining (150), in addition to the factor of S-R association. The same concept might be applicable to a rather novel serial learning prob-

lem devised by Johdai (83) in order to test a Lewinian interpretation of extinction.

Using a retroactive inhibition design and a task requiring the association of key responses with colored lights as stimuli, Ritchie & Muckler (135) tested the effects of two types of interpolated learning. The discriminative type, requiring new correspondences of keys with lights, yielded interference. The motor type, requiring release instead of depression of the keys, yielded facilitation. This difference in effects of the two procedures is the occasion for an interpretation in terms of two phases, selection of the key to be operated, and execution of the movement required to press or release the selected key. It should be noted, however, that the effects of both types of interpolated learning were measured in terms of discriminative performance, i.e., errors in key selection; and during interpolated training with a different method of key operation, there was additional practice on the light-key associations. It is not obvious that the behavior involved in pressing or releasing a key need be assumed to reflect a qualitatively different process from that involved in reaching toward one or another of the alternative keys. There are, to be sure, two independent ways of categorizing the behaviors available to the S into mutually exclusive response classes, but, as Ritchie has pointed out in another context (134), there is no reason to expect the simple relationships of the classical retroactive inhibition paradigm to obtain unless the same classification is followed throughout an experiment.

The more traditional problem of retroactive inhibition in rote verbal learning has been analyzed further by Deese & Hardman (28). They found that in paired-associate learning up to two-thirds of the errors in relearning were intrusions of interpolated material, while with serial lists practically none of the errors in relearning was of this type. Together with the findings of Underwood (173) and Briggs (10), cited above, these results suggest that the paired-associate situation is considerably closer to an adequate S-R analysis than the serial list situation.

Studying transfer effects in a lever-positioning task, Briggs & Brogden (11) found performance on the criterion task to be better when practice had been devoted entirely to the whole task than when a portion of the training period had been devoted to component practice. As in earlier studies of the same problem, the principal interpretive difficulty is that of generalizing the findings to other situations in the absence of any generally acceptable theoretical rationale for the analysis of complex tasks into components.

#### LEARNING THEORY AND RELATED DISCIPLINES

*Ethology.*—The ethologists are a "school" of European investigators of animal behavior with interests cutting across traditional zoology and comparative psychology. They differ from American comparative psychologists in manifesting more obvious affection for their Ss and in relying on semi-experimental field observation rather than on laboratory methods. After spending a period in observing these observers, Verplanck (174) argues that

more interaction between learning theorists and ethologists would help to broaden the inductive basis of learning theories. This conclusion tends to be substantiated by the methodologically admirable studies on habituation decrement reported by Hinde (73, 74). Using frequency of the mobbing response in the chaffinch as his dependent variable, Hinde has obtained quantitative data on the development of habituation decrement, transfer to new stimuli, and recovery during rest intervals which are strikingly comparable to those of laboratory studies dealing with more restricted *S-R* relationships.

A behavioral system described by Russell, Mead & Hayes (140) incorporates ideas from ethology and communication theory, in roughly equal proportions. Two principal types of behavioral mechanism are distinguished: "determination" (deciding between basic behavior patterns) and "adjustment" (modulating chosen patterns to fit the current environmental situation). The two basic mechanisms are thought to correspond to levels in a hierarchy of neural centers. The term "act" is defined as the simple, unanalyzable unit of behavior with its manifestation, "act tendency," expressible as a function of physical variables. The determining variables are categorized into "motivating" and "releasing" factors, corresponding roughly to the motivational and stimulatory variables of American learning theories. This system appears to be at a stage of development comparable to American behavioral theories in the 1930's, and just as insulated from developments on the far side of the Atlantic.

*Perception.*—In giving a new analysis of the role of differentiation in perceptual learning, Gibson & Gibson (55) take a notable step toward narrowing the gap between the vocabularies of perception and discrimination learning. The Gibsons raise the question whether improvement in perception must be regarded as the accrual of meanings, associations, etc., rather than simply as a type of discrimination learning whereby the response becomes dependent upon more and finer aspects of the stimulating situation. In an experiment concerned with the recognition of previously viewed visual figures, they have obtained evidence of a correlation between improvement in identification of figures and increase in frequency of "naming" responses. They conclude that available evidence both from studies of recognition of figures and from psychophysical studies can be interpreted in terms of the learning of "identifying responses." The latter are responses, verbal, motor, or perceptual (i.e., inferred) which are associated with specific sets of observations or events. Working in a very different experimental context, the study of distorted rooms, Kilpatrick (91) has also obtained evidence of *Ss'* reported perceptions changing in the direction of more accurate correspondence with the environmental situation. It is not immediately clear how these lines of investigation should be interpreted by Razran (128) who views conditioning and perception as belonging to different levels in a hierarchy of explanatory principles.

Again in papers by Wickens (185) and Eckstrand & Wickens (37) we find the suggestion that phenomena traditionally labelled "perceptual" may

be interpretable in terms of verbal mediating responses. A more formal variant of this viewpoint is assumed in Binder's (7) model for visual recognition. An important methodological advance associated with Binder's work is the development of mathematical machinery, based on information theory, which can be expected to facilitate the generation of experimentally testable hypotheses.

An earlier experiment which had demonstrated improvement in Ss' ability to judge distances over the ground has been followed up by Gibson & Bergman (54) with a study which includes added controls for possible memorization of specific responses to specific cues. Again improvement is obtained. The findings are interpreted in terms of the development by the S of a "conceptual scale" of distance related to cues available from texture gradients over the ground. It seems clear that the findings could alternatively be interpreted in behavioral terms, with the assumption that classes of judging responses become conditioned to cues from the texture gradients. Although the two types of description are not incompatible, and if suitably developed perhaps empirically indistinguishable, it is likely that they would lead to different experimental continuations.

Working with a psychophysical situation, Parducci (120) has taken ratings of size of singly presented stimuli as a dependent variable and studied this in relation to several independent variables known to be important in learning situations. The results are qualitatively in accord with expectation. In one experiment, for example, Ss first judged a series of small cards, then a series of larger ones, and then were retested with the smaller ones, a retroactive inhibition design. Judgments of the smaller cards were shifted downward to a greater extent as a result of the interpolated series if both types of cards were of the same color than if they were of different colors. This study provides some support both for the idea that learning principles may assist in the interpretation of phenomena usually labelled perceptual and for the suggestion that in some cases learning principles may be effectively studied in the relatively well standardized psychophysical situation.

For anyone even mildly dissatisfied with traditional compartmentalizations, these developments are encouraging, not because they provide immediate solutions to the outstanding problems of either perception or learning, but because they offer hope that both types of phenomena may come to be treated within a common theoretical framework. If the inferential status of perceptual terms can be agreed upon, then research problems can be formulated in theoretically neutral terms (data language), thus facilitating interchange of methods between these fields and eventually the development of common concepts. Also, it will be less easy to produce the illusion of explanation in either field merely by carrying over terminology from the other.

*Information theory.*—Information theory is not a variety of learning theory. What, then, does it have to do with learning phenomena? The answer seems to be that, just as various groups of theorists in the past have found it suggestive or otherwise advantageous to regard the learning organism as a switchboard, a navigator, or an ensemble of vectors, a presently active

group is taken with the idea of regarding the learning organism as a processor of information. [See, e.g., Fitts & Deininger (49); Russell, Mead & Hayes (140).] This change of orientation does not in itself generate any new laws of learning, but it does have the effects of drawing into the study of learning people from allied fields who would otherwise have considered it gauche to cross departmental boundaries, and of encouraging unconventional lines of experimentation and quantitative analysis.

Several studies of discrimination learning ("identification") have been carried out within the framework of information concepts. These studies are typically intermediate in method and design between the usual discrimination learning experiment and the usual psychophysical experiment. The S is instructed concerning the stimuli to be discriminated, as in psychophysics, but improvement with practice is studied as well as asymptotic performance, and both aspects of learning are treated in relation to stimulus and response variables that are scalable in information units. Parenthetically, an interesting parallel between learning experiments influenced by information theory and those influenced by statistical learning theories is the rediscovery of stimulus variation as an independent variable.

An attempt to scale stimulus complexity in terms of information theory has been reported by Gregg (64); he found a direct relation between reaction time and stimulus complexity in a situation where the S had to associate left or right movements of a joy-stick with stimulus characteristics, the stimulus patterns being varied in one, two, three, or four dimensions, all but one of which were irrelevant to correct identification. Similarly, Archer, Bourne & Brown (4), using a concept formation design, found speed and efficiency of performance inversely related to number of irrelevant stimulus dimensions. The generality of this finding is not clear, for Archer (3), under slightly different conditions (classifying stimuli in four dimensions by means of four different responses), found no significant relation between response time and amount of irrelevant information, although the time measure was directly related to amount of relevant information. Using a similar type of learning situation, Bricker (9) added varying numbers of stimulus elements to the minimum needed for correct identification of a stimulus pattern and found an inverse relation between rate of learning and "redundancy" of the stimulus. The result apparently was not in line with expectations, so the next step was an attempt to explain the disparity on the grounds that the redundant stimuli "were not really perceptually redundant." In another analysis Bricker found, this time in accord with expectation, that the more redundant stimuli were better identified than the less redundant ones when elements of the stimulus pattern present during learning were deleted on test trials. From the viewpoint of a neutral observer it would appear that information theorists could better afford to swallow an unpalatable finding once in a while than to shift back and forth between objective and perceptual properties.

A suggestion as to one of the conditions favorable to the effective application of information measures arises from a study of Bruner, Miller &

Zimmerman (14). Studying the recognition of word lists spoken through noise, they found that only at near asymptotic performance did information obtained, in bits per item, become independent of length of list.

The conversion of results into information units is carried to its logical extreme by Rubinstein & Aborn (139). These investigators, in a study of immediate recall of nonsense-syllable lists in relation to degree of organization, report their data only in informational terms, e.g., amount of information in bits recalled per list or per unit of study time. They report more information recalled from lists of lower degrees of organization at all study times, the relation being independent of length of study period over the range studied, and more information being recalled per unit of study time for the shorter study times.

Even a preliminary appraisal of this approach would seem to depend on whether similar relationships appear with other tasks and other types of material; if they do, then the translation into information measures would be justified on grounds of added generality and theoretical significance. On the negative side, the practice of reporting findings solely in terms of the derived measures peculiar to information theory (and the same comment would apply to Hullian theory or any other theory) will not be appreciated by those who wish to collate the results of related empirical studies carried out under the influence of different theoretical orientations.

*Social science.*—One of the more visionary aspects of Hull's program for behavioral science was the plan for ultimate integration of theories of individual and social behavior, with empirically validated laws of the former serving as basic postulates for the latter. The facilitation of this kind of integration by the development of mathematical models at both levels was one of the principal motifs of a summer seminar which has been reported in the recent volume, *Decision Processes* (168). In one of the papers contributed to this volume, Estes (43) discusses some outcomes of recent mathematical investigations of learning which might be relevant to theories of strategy, games, or economic behavior. In another paper Flood (50) notes the correspondence between the concept of strategy in game theory and that of course of action in behavior theory and gives a detailed analysis of a two-person game situation in which one of the players follows a fixed strategy while the other learns in accordance with a stochastic learning model. On the basis of some preliminary investigations, Flood concludes that in certain very simple games, e.g., Morra, an organism learning in accordance with the principles of the learning model will arrive at an approximation of the best strategy available to it. In an experiment growing out of the seminar, Hays & Bush (71) modified the Humphreys-type guessing situation by requiring groups of three college students to respond as units. Evidently three heads are neither better nor worse than one in this situation, for the mean learning curve yielded by 20 of these "subjects" under 75 per cent random reinforcement corresponds closely in both slope and terminal level with curves obtained by previous investigators (32, 45) under more conventional circum-



stances. By further experimentation of this sort it may be possible to determine what assumptions need be added to those of individual learning theory in order to account for changes in patterns of group response to simple learning situations.

#### OVERVIEW

A review of a year's literature on learning is bound to leave one with a feeling of incompleteness unless it is concluded with some brief summary statement characterizing the present state of the field. Our likelihood of arriving at such a statement is, unfortunately, about on a par with that of doing the same for the political situation in Asia. The field of learning represents a loose and shifting confederacy of research traditions with widely varying origins, viewpoints, aspirations, and alliances with other disciplines. The limited progress toward union or integration so far detectable is largely associated with the rather general acceptance of *S-R* reinforcement concepts as a descriptive framework for elementary learning phenomena. A very recent development is the vigorous extension of these concepts to human learning. Doubtless no one expects all phenomena of human learning to yield to this type of analysis, but surprising success has attended efforts to reproduce the better established laws of animal learning with human *Ss*, both child and adult, under suitably simplified conditions. Related methodological trends can be seen even in the traditionally well insulated area of human retention and transfer where closer attention to such matters as response definition is helping to clarify a number of long outstanding problems and paradoxes. The absorption of *S-R* terms into common usage and the growing agreement upon the descriptive power of the reinforcement concept do not, of course, imply that all is serene at the interpretive level. The scope and adequacy of traditional definitions of *S-R* terms are under constant challenge, and explanatory hypotheses relating to reinforcement and extinction are matters of internecine controversy.

The degree of unity and coherence we find in learning theory probably depends in part on the objective situation and in part on our hopes and expectations. The latter, like the theories themselves, change with the times. A decade ago most influential theorists seemed to have as their goal the construction of comprehensive theories capable of embracing all varieties of learning phenomena. However, critical analyses of the major attempts at global theorizing, together with the negative results of sustained attempts to decide experimentally between the competing claims of these systems, indicate that the goal is an unrealistic one. More recent systematic trends have taken several forms: (a) the cultivation of numerous limited theories, usually in close relation to experimental programs; (b) in a few noteworthy cases, the blurring of boundaries associated with traditional chapter headings; and (c) at a more general and abstract level the replacement of verbal schemata by mathematical models.

## LITERATURE CITED

1. Ammons, H., and Irion, A. L., *J. Exptl. Psychol.*, **48**, 184-86 (1954)
2. Amsel, A., and Ward, J. S., *J. Exptl. Psychol.*, **48**, 37-47 (1954)
3. Archer, E. J., *J. Exptl. Psychol.*, **48**, 313-17 (1954)
4. Archer, E. J., Bourne, L. E., Jr., and Brown, F. G., *J. Exptl. Psychol.*, **49**, 153-64 (1955)
5. Baker, R. A., and Osgood, S. W., *J. Exptl. Psychol.*, **48**, 241-46 (1954)
6. Ballard, P. B., *Brit. J. Psychol. Monogr. Suppl.*, **1**(2), 82 pp. (1913)
7. Binder, A., *Psychol. Rev.*, **62**, 119-29 (1955)
8. Bindra, D., Paterson, A. L., and Strzelecki, J., *Can. J. Psychol.*, **9**, 1-6 (1955)
9. Bricker, P. D., *J. Exptl. Psychol.*, **49**, 73-81 (1955)
10. Briggs, G. E., *J. Exptl. Psychol.*, **47**, 285-93 (1954)
11. Briggs, G. E., and Brogden, W. J., *J. Exptl. Psychol.*, **48**, 375-80 (1954)
12. Briggs, G. E., Thompson, R. F., and Brogden, W. J., *J. Exptl. Psychol.*, **48**, 419-23 (1954)
13. Bruner, J. S., Matter, J., and Papanek, M. L., *Psychol. Rev.*, **62**, 1-10 (1955)
14. Bruner, J. S., Miller, G. A., and Zimmerman, C., *J. Exptl. Psychol.*, **49**, 187-92 (1955)
15. Burke, C. J., Estes, W. K., and Hellyer, S., *J. Exptl. Psychol.*, **48**, 153-61 (1954)
16. Bush, R. R., and Mosteller, F., *Psychol. Rev.*, **58**, 413-23 (1951)
17. Bush, R. R., Mosteller, F., and Thompson, G. L., in *Decision Processes*, 99-126 (Thrall, R. M., Coombs, C. H., and Davis, R. L., Eds., John Wiley & Sons, Inc., New York, N. Y., 332 pp., 1954)
18. Buss, A. H., *J. Exptl. Psychol.*, **45**, 75-81 (1953)
19. Buxton, C. E., *Ann. Rev. Psychol.*, **2**, 23-44 (1951)
20. Calvin, A. D., and Seibel, J. L., *J. Exptl. Psychol.*, **48**, 339-42 (1954)
21. Calvin, J. S., Bicknell, E. A., and Sperling, D. S., *J. Comp. Physiol. Psychol.*, **46**, 173-75 (1953)
22. Campbell, D. T., *Psychol. Rev.*, **61**, 167-74 (1954)
23. Cantor, G. N., and Spiker, C. C., *J. Exptl. Psychol.*, **47**, 256-58 (1954)
24. Coppock, H. W., *J. Comp. Physiol. Psychol.*, **47**, 109-13 (1954)
25. Coppock, H. W., and Chambers, R. M., *J. Comp. Physiol. Psychol.*, **47**, 355-57 (1954)
26. Crum, J., Brown, W. L., and Bitterman, M. E., *Am. J. Psychol.*, **64**, 228-37 (1951)
27. Davis, A. D., *J. Exptl. Psychol.*, **48**, 275-77 (1954)
28. Deese, J., and Hardman, G. W., *Am. J. Psychol.*, **67**, 299-307 (1954)
29. Delgado, J. M. R., Roberts, W. W., and Miller, N. E., *Am. J. Physiol.*, **179**, 587-93 (1954)
30. Denny, M. R., and Dunham, M. D., *J. Exptl. Psychol.*, **41**, 382-89 (1951)
31. Denny, M. R., Frisbey, N., and Weaver, J., Jr., *J. Exptl. Psychol.*, **49**, 48-54 (1955)
32. Detambel, M. H., *J. Exptl. Psychol.*, **49**, 97-104 (1955)
33. DeValois, R. L., *J. Exptl. Psychol.*, **47**, 392-98 (1954)
34. Dinsmoor, J. A., *Psychol. Rev.*, **62**, 96-105 (1955)
35. Diven, K., *J. Psychol.*, **3**, 291-308 (1937)
36. Dufort, R. H., Guttman, N., and Kimble, G. A., *J. Comp. Physiol. Psychol.*, **47**, 248-49 (1954)
37. Eckstrand, G. A., and Wickens, D. D., *J. Exptl. Psychol.*, **47**, 274-78 (1954)
38. Edmonson, B. W., and Amsel, A., *J. Comp. Physiol. Psychol.*, **47**, 117-23 (1954)



39. Ehrenfreund, D., *J. Comp. Physiol. Psychol.*, **47**, 311-14 (1954)
40. Elam, C. B., Tyler, D. W., and Bitterman, M. E., *J. Comp. Physiol. Psychol.*, **47**, 381-84 (1954)
41. Estes, W. K., Koch, S., MacCorquodale, K., Meehl, P. E., Mueller, C. G., Jr., Schoenfeld, W. N., and Verplanck, W. S., *Modern Learning Theory* (Appleton-Century-Crofts, Inc., New York, N. Y., 379 pp., 1954)
42. Estes, W. K., in *Symposium on Psychology of Learning Basic to Military Training Problems*, 21-38 (Research and Development Board, Washington, D. C., 195 pp., 1954)
43. Estes, W. K., in *Decision Processes*, 127-38 (Thrall, R. M., Coombs, C. H., and Davis, R. L., Eds., John Wiley & Sons, Inc., New York, N. Y., 332 pp., 1954)
44. Estes, W. K., and Burke, C. J., *Psychol. Rev.*, **60**, 276-86 (1953)
45. Estes, W. K., and Straughan, J. H., *J. Exptl. Psychol.*, **47**, 225-34 (1954)
46. Farber, I. E., in *Nebraska Symposium on Motivation*, 1-46 (Jones, M. R., Ed., University of Nebraska Press, Lincoln, Nebr., 322 pp., 1954)
47. Ferster, C. B., *Science*, **120**, 269-70 (1954)
48. Fields, P. E., *J. Comp. Physiol. Psychol.*, **47**, 472-76 (1954)
49. Fitts, P. M., and Deininger, R. L., *J. Exptl. Psychol.*, **48**, 483-92 (1954)
50. Flood, M. M., in *Decision Processes*, 139-58 (Thrall, R. M., Coombs, C. H., and Davis, R. L., Eds., John Wiley & Sons, Inc., New York, N. Y., 332 pp., 1954)
51. Flood, M. M., in *Decision Processes*, 287-300 (Thrall, R. M., Coombs, C. H., and Davis, R. L., Eds., John Wiley & Sons, Inc., New York, N. Y., 332 pp., 1954)
52. Freeburne, C. M., and Schneider, M., *J. Exptl. Psychol.*, **49**, 181-86 (1955)
53. Galanter, E., and Shaw, W. A., *J. Comp. Physiol. Psychol.*, **47**, 395-98 (1954)
54. Gibson, E. J., and Bergman, R., *J. Exptl. Psychol.*, **48**, 473-82 (1954)
55. Gibson, J. J., and Gibson, E. J., *Psychol. Rev.*, **62**, 32-41 (1955)
56. Glanzer, M., *Psychol. Rev.*, **60**, 257-69 (1953)
57. Gonzalez, R. C., Gentry, G. V., and Bitterman, M. E., *J. Comp. Physiol. Psychol.*, **47**, 385-88 (1954)
58. Goodnow, J. J., *Am. J. Psychol.*, **68**, 106-16 (1955)
59. Goodnow, J. J., and Postman, L., *J. Exptl. Psychol.*, **49**, 16-22 (1955)
60. Gordon, W. M., and Berlyne, D. E., *Quart. J. Exptl. Psychol.*, **6**, 181-85 (1954)
61. Goss, A. E., *Psychol. Rev.*, **62**, 20-31 (1955)
62. Green, E. J., *J. Exptl. Psychol.*, **49**, 175-80 (1955)
63. Greenspoon, J., *The Effect of Verbal and Nonverbal Stimuli on the Frequency of Members of Two Verbal Response Classes* (Doctoral thesis, Indiana University, Bloomington, Ind., 41 pp., 1950)
64. Gregg, L. W., *J. Exptl. Psychol.*, **48**, 289-97 (1954)
65. Grice, G. R., *J. Abnormal Social Psychol.*, **50**, 71-74 (1955)
66. Grosslight, J. H., Hall, J. F., and Scott, W., *J. Exptl. Psychol.*, **48**, 173-74 (1954)
67. Guthrie, E. L., *The Psychology of Learning* (Harper & Brothers, New York, N. Y., 310 pp., 1952)
68. Guttman, N., *J. Comp. Physiol. Psychol.*, **47**, 358-61 (1954)
69. Harlow, H. F., in *Learning Theory, Personality Theory, and Clinical Research*, 36-53 (The Kentucky Symposium, John Wiley & Sons, Inc., New York, N. Y., 164 pp., 1954)
70. Harrison, J. M., and Tracy, W. H., *Science*, **121**, 373-74 (1955)
71. Hays, D. G., and Bush, R. R., *Am. Sociol. Rev.*, **19**, 693-701 (1954)
72. Hilgard, E. R., Jones, L. V., and Kaplan, S. J., *J. Exptl. Psychol.*, **42**, 94-99 (1951)
73. Hinde, R. A., *Proc. Roy. Soc. (London)*, [B]**142**, 306-31 (1954)

74. Hinde, R. A., *Proc. Roy. Soc. (London)*, [B]142, 331-58 (1954)
75. Hovland, C. I., in *Handbook of Experimental Psychology*, 613-89 (Stevens, S. S., Ed., John Wiley & Sons, Inc., New York, N. Y., 1436 pp., 1951)
76. Hull, C. L., *Principles of Behavior* (Appleton-Century-Crofts, Inc., New York, N. Y., 422 pp., 1943)
77. Hull, C. L., *Essentials of Behavior* (Yale University Press, New Haven, Conn., 144 pp., 1951)
78. Hull, C. L., *A Behavior System* (Yale University Press, New Haven, Conn., 372 pp., 1952)
79. Hurwitz, H. M. B., *Quart. J. Exptl. Psychol.*, 6, 62-71 (1954)
80. Hurwitz, H. M. B., *Quart. J. Exptl. Psychol.*, 7, 1-7 (1955)
81. Hutt, P. J., *J. Comp. Physiol. Psychol.*, 47, 235-39 (1954)
82. Jenkins, W. O., and Stanley, J. C., *Psychol. Bull.*, 47, 193-234 (1950)
83. Johdai, K., *J. Exptl. Psychol.*, 49, 193-99 (1955)
84. Kagan, J., *J. Comp. Physiol. Psychol.*, 48, 59-64 (1955)
85. Kagan, J., and Berkun, M., *J. Comp. Physiol. Psychol.*, 47, 108 (1954)
86. Kanfer, F. H., *J. Exptl. Psychol.*, 48, 424-32 (1954)
87. Keller, F. S., *Learning (Reinforcement Theory)*. Doubleday Papers in Psychology (Doubleday & Co., Inc., New York, N. Y., 37 pp., 1954)
88. Kendler, H. H., *Psychol. Rev.*, 59, 269-77 (1952)
89. Kendler, H. H., and D'Amato, M. F., *J. Exptl. Psychol.*, 49, 165-74 (1955)
90. Kendler, H. H., and Vineberg, R., *J. Exptl. Psychol.*, 48, 252-58 (1954)
91. Kilpatrick, F. P., *J. Exptl. Psychol.*, 47, 362-70 (1954)
92. Koch, S., in *Modern Learning Theory*, 1-176 (Appleton-Century-Crofts, Inc., New York, N. Y., 397 pp., 1954)
93. Lacey, J. I., and Smith, R. L., *Science*, 120, 1045-51 (1954)
94. Lauer, D. W., and Estes, W. K., *J. Comp. Physiol. Psychol.*, 48, 8-13 (1955)
95. Lawrence, D. H., *J. Exptl. Psychol.*, 40, 175-88 (1950)
96. Lawrence, D. H., *J. Comp. Physiol. Psychol.*, 45, 511-16 (1952)
97. Lawrence, D. H., *J. Gen. Psychol.*, 52, 37-48 (1955)
98. Lawrence, D. H., and DeRivera, J., *J. Comp. Physiol. Psychol.*, 47, 465-71 (1954)
99. Lawrence, D. H., and Mason, W. A., *J. Comp. Physiol. Psychol.*, 48, 1-7 (1955)
100. MacCaslin, E. F., *Am. J. Psychol.*, 67, 308-14 (1954)
101. Mahut, H., *Can. J. Psychol.*, 8, 130-38 (1954)
102. Maier, N. R. F., in *Learning Theory, Personality Theory, and Clinical Research*, 54-65 (The Kentucky Symposium, John Wiley & Sons, Inc., New York, N. Y., 164 pp., 1954)
103. Mandler, G., *Psychol. Rev.*, 61, 235-44 (1954)
104. Mandler, G., *J. Exptl. Psychol.*, 47, 411-17 (1954)
105. McGeoch, J. A., and Irion, A. L., *The Psychology of Human Learning* (Longmans, Green & Co., New York, N. Y., 596 pp., 1952)
106. Melching, W. H., *J. Comp. Physiol. Psychol.*, 47, 370-74 (1954)
107. Melton, A. W., *Ann. Rev. Psychol.*, 1, 9-30 (1950)
108. Michels, K. M., *J. Comp. Physiol. Psychol.*, 48, 32-36 (1955)
109. Miller, N. E., and Dollard, J., *Social Learning and Imitation* (Yale University Press, New Haven, Conn., 341 pp., 1941)
110. Moeller, G., *J. Exptl. Psychol.*, 48, 162-66 (1954)
111. Moltz, H., *J. Exptl. Psychol.*, 47, 418-24 (1954)
112. Morin, R. E., and Grant, D. A., *J. Exptl. Psychol.*, 49, 39-47 (1955)
113. Myers, A. K., and Miller, N. E., *J. Comp. Physiol. Psychol.*, 47, 428-36 (1954)

114. Neimark, E. D., *Effects of Type of Non-reinforcement and Number of Alternative Responses in Two Verbal Conditioning Situations* (Doctoral thesis, Indiana University, Bloomington, Ind., 98 pp., 1953)
115. Neimark, E. D., and Saltzman, I. J., *Am. J. Psychol.*, **66**, 618-21 (1953)
116. Nissen, H. W., *Psychol. Rev.*, **57**, 121-31 (1950)
117. Noble, C. E., *J. Exptl. Psychol.*, **49**, 93-96 (1955)
118. Olds, J., and Milner, P., *J. Comp. Physiol. Psychol.*, **47**, 419-27 (1954)
119. Page, H. A., *J. Comp. Physiol. Psychol.*, **48**, 14-16 (1955)
120. Parducci, A., *J. Exptl. Psychol.*, **48**, 24-30 (1954)
121. Perkins, C. C., Jr., and Tilton, J. R., *J. Comp. Physiol. Psychol.*, **47**, 341-43 (1954)
122. Perkins, M. J., Banks, H. P., and Calvin, A. D., *J. Exptl. Psychol.*, **48**, 416-18 (1954)
123. Postman, L., *Psychol. Monographs*, **68**(3), 24 pp. (1954)
124. Postman, L., and Adams, P. A., *Am. J. Psychol.*, **67**, 612-31 (1954)
125. Postman, L., Adams, P. A., and Phillips, L. W., *J. Exptl. Psychol.*, **49**, 1-10 (1955)
126. Postman, L., and Phillips, L. W., *J. Exptl. Psychol.*, **48**, 48-56 (1954)
127. Ramond, C. K., *J. Exptl. Psychol.*, **47**, 248-50 (1954)
128. Razran, G., *Psychol. Rev.*, **62**, 83-95 (1955)
129. Reid, L. S., and Slivinske, A. J., *J. Comp. Physiol. Psychol.*, **47**, 306-10 (1954)
130. Restle, F., *Psychol. Rev.*, **62**, 11-19 (1955)
131. Riopelle, A. J., *J. Exptl. Psychol.*, **49**, 28-32 (1955)
132. Riopelle, A. J., and Copelan, E. L., *J. Exptl. Psychol.*, **48**, 143-45 (1954)
133. Ritchie, B. F., in *Nebraska Symposium on Motivation*, 46-55 (Jones, M. R., Ed., University of Nebraska Press, Lincoln, Nebr., 322 pp., 1954)
134. Ritchie, M. L., *Psychol. Rev.*, **61**, 267-70 (1954)
135. Ritchie, M. L., and Muckler, F. A., *J. Exptl. Psychol.*, **48**, 409-15 (1954)
136. Robinson, J. S., *J. Exptl. Psychol.*, **49**, 112-14 (1955)
137. Rothkopf, E. Z., *J. Exptl. Psychol.*, **49**, 33-38 (1955)
138. Rothkopf, E. Z., and Zeaman, D., *J. Psychol.*, **34**, 235-55 (1952)
139. Rubenstein, H., and Aborn, M., *J. Exptl. Psychol.*, **48**, 146-52 (1954)
140. Russell, W. M. S., Mead, A. P., and Hayes, J. S., *Behaviour*, **6**, 153-205 (1954)
141. Saltzman, I. J., and Atkinson, R. L., *Am. J. Psychol.*, **67**, 521-24 (1954)
142. Scharlock, D. P., *J. Exptl. Psychol.*, **48**, 31-36 (1954)
143. Schoeffler, M. S., *J. Exptl. Psychol.*, **48**, 323-29 (1954)
144. Seward, J. P., *Psychol. Rev.*, **61**, 145-59 (1954)
145. Sheffield, F. D., Roby, T. B., and Campbell, B. A., *J. Comp. Physiol. Psychol.*, **47**, 349-54 (1954)
146. Sheffield, V. F., *J. Exptl. Psychol.*, **39**, 511-26 (1949)
147. Sidman, M., *J. Comp. Physiol. Psychol.*, **47**, 399-402 (1954)
148. Sidowski, J. B., *J. Exptl. Psychol.*, **48**, 355-60 (1954)
149. Siegel, P. S., and MacDonnell, M. F., *J. Comp. Physiol. Psychol.*, **47**, 250-52 (1954)
150. Skinner, B. F., *The Behavior of Organisms* (D. Appleton-Century Co., Inc., New York, N. Y., 457 pp., 1938)
151. Skinner, B. F., *Psychol. Rev.*, **57**, 193-216 (1950)
152. Smith, K., *Psychol. Rev.*, **61**, 217-25 (1954)
153. Smith, M. H., Jr., and Hoy, W. J., *J. Exptl. Psychol.*, **48**, 259-64 (1954)
154. Solomon, R. L., and Wynne, L. C., *Psychol. Rev.*, **61**, 353-85 (1954)
155. Spence, K. W., *Psychol. Rev.*, **44**, 430-44 (1937)

156. Spence, K. W., *Psychol. Rev.*, **59**, 89-93 (1952)
157. Spence, K. W., *Psychol. Rev.*, **61**, 209-16 (1954)
158. Spence, K. W., in *Learning Theory, Personality Theory, and Clinical Research*, 1-21 (The Kentucky Symposium, John Wiley & Sons, Inc., New York, N. Y., 164 pp., 1954)
159. Spence, K. W., and Beecroft, R. S., *J. Exptl. Psychol.*, **48**, 399-403 (1954)
160. Spence, K. W., Farber, I. E., and Taylor, E., *J. Exptl. Psychol.*, **43**, 404-8 (1954)
161. Stanley, W. C., and Aamodt, M. S., *J. Comp. Physiol. Psychol.*, **47**, 462-64 (1954)
162. Stanley, W. C., and Rowe, M. I., *J. Exptl. Psychol.*, **48**, 271-74 (1954)
163. Starkweather, J. A., and Duncan, C. P., *J. Exptl. Psychol.*, **47**, 351-56 (1954)
164. Stevenson, H. W., and Iscoe, I., *J. Exptl. Psychol.*, **47**, 251-55 (1954)
165. Stevenson, H. W., and Iscoe, I., *J. Exptl. Psychol.*, **49**, 11-15 (1955)
166. Taylor, J. A., *J. Abnormal Social Psychol.*, **48**, 285-90 (1953)
167. Thompson, M. E., and Thompson, J. P., *J. Exptl. Psychol.*, **39**, 883-91 (1949)
168. Thrall, R. M., Coombs, C. H., and Davis, R. L., Eds., *Decision Processes* (John Wiley & Sons, Inc., New York, N. Y., 332 pp., 1954)
169. Tolman, E. C., Ritchie, B. F., and Kalish, D., *J. Exptl. Psychol.*, **36**, 221-26 (1946)
170. Underwood, B. J., *Ann. Rev. Psychol.*, **4**, 31-58 (1953)
171. Underwood, B. J., *Psychol. Rev.*, **61**, 160-66 (1954)
172. Underwood, B. J., *Psychol. Bull.*, **51**, 276-82 (1954)
173. Underwood, B. J., *J. Exptl. Psychol.*, **47**, 294-300 (1954)
174. Verplanck, W. S., *Psychol. Rev.*, **62**, 139-44 (1955)
175. Voeks, V. W., *J. Psychol.*, **30**, 341-62 (1950)
176. Voeks, V. W., *J. Psychol.*, **39**, 289-99 (1955)
177. Walker, E. L., Dember, W. N., Earl, R. W., Fliege, S. E., and Karoly, A. J., *J. Comp. Physiol. Psychol.*, **48**, 24-28 (1955)
178. Walker, E. L., Dember, W. N., Earl, R. W., and Karoly, A. J., *J. Comp. Physiol. Psychol.*, **48**, 19-23 (1955)
179. Ward, L. B., *Psychol. Monographs*, **49**(4), 64 pp. (1937)
180. Warren, J. M., *J. Comp. Physiol. Psychol.*, **47**, 290-92 (1954)
181. Warren, J. M., *Am. J. Psychol.*, **67**, 517-20 (1954)
182. Warren, J. M., *Am. J. Psychol.*, **67**, 720-22 (1954)
183. Weinstock, S., *J. Comp. Physiol. Psychol.*, **47**, 318-22 (1954)
184. Weiss, W., and Margolius, G., *J. Exptl. Psychol.*, **48**, 318-22 (1954)
185. Wickens, D. D., in *Learning Theory, Personality Theory, and Clinical Research*, 22-35 (The Kentucky Symposium, John Wiley & Sons, Inc., New York, N. Y., 164 pp., 1954)
186. Wickens, D. D., and Miles, R. C., *J. Comp. Physiol. Psychol.*, **47**, 315-17 (1954)
187. Wike, E. L., and Casey, A., *J. Comp. Physiol. Psychol.*, **47**, 240-43 (1954)
188. Wike, E. L., and Casey, A., *J. Comp. Physiol. Psychol.*, **47**, 441-43 (1954)
189. Wodinsky, J., Varley, M. A., and Bitterman, M. E., *J. Comp. Physiol. Psychol.*, **47**, 337-40 (1954)
190. Young, F. A., *J. Exptl. Psychol.*, **48**, 62-68 (1954)
191. Young, P. T., and Shuford, E. H., Jr., *J. Comp. Physiol. Psychol.*, **47**, 298-305 (1954)
192. Zeaman, D., Deane, G., and Wegner, N., *J. Psychol.*, **38**, 235-50 (1954)
193. Zeaman, D., and House, B. J., *J. Exptl. Psychol.*, **41**, 177-86 (1951)
194. Zeaman, D., and Wegner, N., *J. Exptl. Psychol.*, **48**, 349-54 (1954)

## PERSONALITY<sup>1,2</sup>

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What follows is an attempt at broad coverage of the literature, except for articles which merely report case studies or test results, expound psychoanalytic theory, or deal with personality development, an area covered elsewhere in this volume. While such an approach forces many involved arguments into a very short space (and in condensing often does violence to them), it may serve to encourage research scientists to spread their energies beyond certain popular problems to relatively untouched ones. To pursue this approach obviously requires some over-all frame of reference; the one adopted will be the same as the author has used previously in his book *Personality* (86), i.e., methodological and theoretical considerations, traits, schemas (or ideas and values), and motives.

### METHODOLOGICAL AND THEORETICAL CONSIDERATIONS

The study of personality is especially given to the use of rating scales (and this year is no exception), partly because its variables are hard to measure objectively and partly because there is a desire for a "wholistic" assessment of personality. But Zubin (153) has argued (correctly in my view) that "height, weight, time, and warmth were evaluated subjectively long before objective measuring devices became available," and that it is time for personality psychologists to throw away their rating scales and replace them with more objective measuring devices such as scientists have in other fields. The difficulty with rating scales is nicely illustrated in a study reported by Barron (11) on the "personal soundness" of university graduate students. His approach is to determine the test or behavioral correlates of "soundness" as judged by departmental staffs and by the psychological staff of an assessment center where the students were interviewed and tested. Methodologically it is impossible to say whether this is a study in social perception or in personality processes. That is, what Barron may be discovering is what cues psychologists, as compared with other persons, attend to when they make judgments of "personal soundness." If this is so, the title of the research should be changed from "Personal soundness . . ." to "Determinants of the perception of personal soundness . . ." Of course, it is also

<sup>1</sup> The survey of the literature pertaining to this review was completed in April, 1955.

<sup>2</sup> The following abbreviations are used in this chapter: F-scale (California scale for measuring authoritarianism); MAPS (Make a Picture Story Test); MMPI (Minnesota Multiphasic Personality Inventory); Q-sort (method of getting subjects to sort 100 self-descriptive statements into nine piles according to a forced normal distribution); S-R (stimulus-response); TAT (Thematic Apperception Test).

true that the perception is in part determined by personality processes in the student being judged, which have an indeterminate relationship to what the judges call them. The methodological problem is that a judgment is determined both by factors in the person being judged and by personality factors in the judge. The resulting measurement, no matter how precise numerically, is anything but precise conceptually and does not seem to be a sound basis on which to build psychological theory.

Another methodological issue which has received some attention during the year is the influence of the concrete social or interpersonal situation on personality measurement. Thus, Kurtz & Riggs (75) and Rabin *et al.* (113) have demonstrated that while previous set either from a word-completion test or from pictures of anatomy will not carry over automatically to influence Rorschach test responses, the sex of the examiner and his relationship to the tester will affect the content of the Rorschach (113). The controversy between Siipola (126) and Lazarus & Oldfield (79) as to the meaning of the color response on the Rorschach seems to boil down in part to a question of whether the conflict between form and color determinants indicates emotionality only when the subject is under time pressure or the pressure of certain types of test administration. The significance (and correlates) of Rorschach or other test responses may depend a good deal on the conditions of administration, whether, for example, the person being tested thinks something important depends on the outcome, e.g., a mental hospital setting, or whether the test is a kind of "game" for him, e.g., a college student setting. As further illustrations of the importance of this situational factor, Abernethy (1) has demonstrated that the trouble score on the Bell Adjustment Inventory will increase under anonymous conditions as compared with when the score is to be public knowledge, and Parrish & Rethlingshafer (111) failed to replicate some of the work of McClelland *et al.* on the achievement motive (88), possibly because they used individual rather than group, impersonal test administration conditions.

A third methodological controversy centers in the wholistic, structural psychodiagnostic approach to personality vigorously defended by Wellek (144, 145) versus the dimensional, operational approach ably expounded by Eysenck in three languages (37, 38, 40) and answered by Schick (120) from the German point of view. De Groot (28) takes a more middle-of-the-road position which leans toward Eysenck's view while stressing at the same time the need for remembering that the individual scientist must use intuitive "understanding" in setting up his categories for analysis and measurement. Wellek's over-view of instruments available for psychodiagnosis (144) covers a point frequently overlooked by contemporary American psychologists, namely the fact that one can study differences in the process by which an individual achieves a percept or concept as well as the differences in the end product itself. Most American psychodiagnostic techniques do not permit the former type of analysis.

The typical American concern in the psychodiagnostic field has been as

usual with whether or not such techniques "work," with whether they will predict any criteria. But validity has been under attack on several fronts. Sundberg (138) has shown that the person himself is a poor judge of the acceptability of a diagnosis since he cannot distinguish his own clinical description from a fake one and since the acceptability of a self-description depends on whether it is short and contains terms which are "vague, double-headed, modal, and favorable." While Little & Shneidman (83) have shown that *Q*-sorts based on the results of MAPS and TAT agree with *Q*-sorts made by clinicians unaided by these tests, Miles (97) objects that procedures of this sort may simply reflect the degree to which the individuals concerned have learned their lessons, that is, have learned to respond to similar cues with similar labels. A major attempt by Holtzman & Sells (60) to predict flying success by clinical analysis of test protocols ended in complete failure. Not one clinical psychologist, using all the material provided him in any way he liked, was able to predict flying success better than chance (though one was significantly worse than chance); nor were the psychologists as a group significantly better than chance. Hamlin (56) argues that despite such widely publicized negative results it is still true that the clinician can predict with his projective instruments such crude criteria as intelligence and degree of adjustment. A skeptic might still ask, however, whether the clinician could not predict such criteria just as well by looking the patient in the eye or chatting with him for five minutes. Zubin (154) in reviewing the history of the Rorschach technique concludes that the attempt to predict criteria on the basis of perceptual signs has been a failure, but that global personalistic approaches and content analyses of the actual associations elicited by the blots have been more successful. He feels that the Rorschach is best considered as an aid to the interview. His answer to Holtzman & Sells would apparently be that the clinicians failed because they were not able to see and interview the subjects and properly evaluate the meaning of the test materials in terms of this all-important context.

There were several major attempts to integrate various aspects of personality under a single theoretical formulation during the year, one based on learning theory, one on concept categorization, one on clinical judgments, and one on factor analysis. Rotter (116) has worked out a system for analyzing personality in terms of constructs like behavior potential, expectancy, and reinforcement. His propositions and their interrelations are carefully stated and tested in some instances by experiments designed to operationalize the system. The approach is more deductive than inductive, being patterned after Hull and the learning theorists, although he also manages to cover most of the standard facts and theories of personality within his framework. Kelly (68) has worked out an equally complete system, the operational core of which appears to be the Repertory Test which is a method of getting at personal constructs through "the familiar concept-formation test procedure." Leary & Coffey (80) have developed an inclusive scheme for describing personality in terms of 16 ways in which a person may interact



with others, e.g., "trustful-docile," "executive-autocratic." The variables form a circular continuum in which adjacent variables are positively correlated whereas those situated 180° apart are negatively correlated. Also, as one goes from the center of the circle to the outside, one goes from moderate or adjustable behavior to intense or maladjustive behavior as the terms "trustful-docile" and "executive-autocratic" suggest. Subjects get scores in each of the 16 sectors of the circle, and these may all be condensed for certain purposes into a single point representing the subject's summary position in the personality sphere. Finally, these authors recognize that there are three levels at which the person must be measured: private (as he appears to himself), public (as he appears to others), and symbolic (as he reveals himself in projective materials). They point out that it is most important to compare the position of the subject at these three levels in terms of the same descriptive set of variables because such a comparison may reveal important discrepancies. That is, a person may show much aggression at Level III (symbolically), but neither perceive it in himself (Level I) nor show it socially (Level II). Many personality theorists like the Rogers group (115) work almost exclusively at Level I. Leary & Coffey propose their system as a substitute for traditional psychiatric classification and point out that six of their modes of response do in fact correspond more or less to six of the classic psychiatric categories.

Eysenck (37 to 40) has continued to make his case based on factor analysis for describing personality in terms of three sets of orthogonal dimensions: psychoticism, normality-neuroticism, and extroversion-introversion. A person's position on these dimensions seems to him to be determined roughly 80 per cent by heredity, at least in our culture (40, p. 175). Most of Eysenck's attention this year has been directed at understanding the extroversion-introversion dimension which also corresponds to the continuum bounded by the hysterics and the anxiety-neurotics (dysthymics). His theory in general terms is that individuals differ, primarily by heredity, in the amount of inhibition produced in the central nervous system by an *S-R* event and that, in general, anxiety-neurotics show little reactive inhibition whereas hysterics show a lot. From these assumptions he makes the predictions, many of which are at least partly confirmed, that hysterics will be extroverted, that they will condition with more difficulty than anxiety cases, that they will show greater figural after-effects, and that they will tend to be under-socialized and more prone to psychopathy. He is currently exploring the consequences of innate differences in reactive inhibition not only for phenomena of learning and perception, but also for social attitudes, for types of psychotherapy indicated (e.g., "strengthening" the super-ego, as Mowrer recommends, for the extroverts and "weakening" it, as Miller and Dollard recommend, for introverts, etc.), for drug studies, and for its implication for psychoanalytic theory which tends to regard introversion-extroversion not as a dimension but as alternative adjustment mechanisms which can be readily adopted simply as a matter of ego strategy.



## TRAITS

Trait studies might be classified according to the two main methods of studying them, one involving factor analysis and the other the correlation of two or more test responses assumed to be similar. Barron (12) has added a slightly new methodological twist in demonstrating that individuals who project movement readily into inkblots are perceived by others to be more intelligent, inventive, and introspective, in short, to be more "introversive" just as Rorschach had stated originally. The new twist is, of course, that what the Rorschach may give a clue to is not the person's actual trait behavior (the usual method of checking its validity) but the way that behavior will be perceived by others.

Trait studies might also be classified in terms of their popularity. If they were, rigidity and social sensitivity would win hands down! However, in this chapter the studies will be grouped according to the author's classification scheme for personality traits (86) in an attempt to show gaps in current research.

*Movement traits.*—Of the small number of studies of expressive movement and its usual correlate, physique, published during the past year, the one of chief importance was Stewart's (136) on the expression of personality in drawings and paintings. Stewart was able to group his 31 measured variables into six clusters which could be given names like "skill," "realism," and "symmetry." However, since these variables seem more or less specific to Stewart's testing situation, the chief dimensions of expression would appear to be as far from being settled as ever.

*Cognitive traits.*—In this area much more research has been done. Mooney (98) reports that he discovered three closure factors, one verbal, one conceptual, and one visual-perceptual. In a somewhat related area Lofchie (84) and Lane (77) have demonstrated that a "perceptual maturity" index based on the Rorschach according to a developmental scheme worked out by Werner will predict how socially effective subjects will be judged and also how well they will perform on a psychomotor task under distraction stress. What seems to be involved here is a developmental trait of restricting attention to relevant perceptual stimuli. The same trait may be involved in Doane's factorial study (31) of integration in which he was trying to test the capacity to keep several things in mind at once during the performance of complex routine tasks. Klein's research (72) on constrictive and flexible cognitive controls also seems to belong in the general area of how the person has learned to deal effectively with the variety of incoming stimuli. He found that subjects who can easily ignore the meaning of a color word, even when naming a conflicting color in which it is typed (the "flexible controllers"), tend to overestimate perceptually, and, under the influence of a thirst drive, show greater peripheral efficiency in a tachistoscopic experiment and fewer stimulus-bound associations in free associations to a thirst-related cue word. In other words, flexibility-constriction seems to be a gen-

eral trait which runs through a number of areas of cognitive functioning and which seems to be accentuated by increase in drive level.

Some of the rigidity studies also seem to fit in here. Rapid perception of distortion with aniseikonic lenses has been shown to be associated with Rorschach signs of low rigidity by Becker (13) and with a tendency to ask relatively few questions in an ambiguous interview situation by Martin (91). Bandura (10) has demonstrated a moderate relationship between tendency to use white space on the Rorschach and rate of reversal of a Necker cube. In all these situations what seems to be involved is a trait of adapting easily (flexibly) or with difficulty (rigidly, constrictively) to changes in the perceptual situation.

As to dominant modes of perceiving the world, factor analytic studies originating in Guilford's (58, 148) and Cattell's (18, 19) laboratories have reported the usual verbal, numerical, and perceptual factors in the context of researches aimed at getting at other factors as well. Although the average intercorrelation among his tests was rather low, Keehn (67) maintains that there is a fairly general factor representing color or form dominance. There is a hint in the Guilford studies (58, 148) that evaluative [Hertzka *et al.* (58)] and creative thinking [Wilson *et al.* (148)] abilities may also be in part specific to the mode of approach to the world. Hence, there are evaluative factors associated with perceptual, verbal, logical, etc. modes of response. Perhaps it is too optimistic to hope for, but it would certainly simplify matters if the mass of first order trait factors so far discovered could be reduced to combinations of a few basic modes of approach (perceptual, numerical, logical, etc.) and to a few basic ways in which they can be modified (speed, ease of change, normality-originality, etc.).

Cattell *et al.* (18) have reported the final stage, involving behavior in objective test situations, in the senior author's attempt to check factorial findings by comparing these test factors with those based on behavior ratings and questionnaires. Enough marker variables were included to "hold the pattern" of the factors and to demonstrate which behaviors of subjects in objective test settings belonged with various questionnaire factors. The conception of this research design is ambitious, and the seven or eight factors which appear to the authors to be worth further study are encouragingly familiar, but discouragingly faint. Furthermore, as we shall see below, a number of them appear to dissolve on more careful individual study.

The trait of cognitive orientation inwards or outwards has kept reappearing in Eysenck's work (37, 40) referred to earlier, in a study by Heron (57) where it appeared along with such classic factors as neuroticism and speed of approach, and in Barron's work (12) on the judged introversion of people who readily project movement into inkblots.

*Performance traits.*—Two studies, one by Wolff (151) and one by Secord (123), have thrown some doubt on the existence of a generalized trait of performance variability or uncertainty. MacArthur (85) has uncovered what appears to be a strong general factor behind 21 measures of persistence in

secondary school boys. Other studies have concentrated largely on the rigidity trait as it appears cognitively (the evidence for which has been reviewed above) or in performance. Schmidt *et al.* (121) have noted a significant relationship between rigidity on the Luchin *Einstellung* problems and the Wesley rigidity scale which chiefly involves self-description. Applezweig (4) found no general trait of rigidity and concluded that rigidity of performance depends on the nature of the test and the testing conditions. Scheier (118) also found neither a general factor of cognitive rigidity nor one of motor rigidity. Rim (114) concludes that perseveration is not a unity but really involves rigidity of old habits, cognitive rigidity and alternation or speed of change of old habits, whereas Mooney (98) found the usual factor of perceptual flexibility-nonflexibility and Cattell *et al.* (18) reported not only the traditional classical motor rigidity factor, rejected by Scheier (118), but also a kind of generalized indecisiveness factor somewhat analogous to the uncertainty trait rejected by Wolff (151). The best conclusion one can draw seems to be that the status of rigidity as a trait variable is, to say the least, uncertain!

*Emotional traits.*—Emotional traits were not much studied this year, although in the course of determining what factors were associated with four types of leadership, Cattell & Stice (19) learned that their previously isolated factor, "adventurous cyclothymia," is significantly associated with leadership. This same study yielded some information about the ascendance dimension of social traits. That is, it showed which of Cattell's 16 primary factors were associated with dominance in interpersonal situations. In addition to "cyclothymia," these included such factors as "deliberate will control," "character integration," and "absence of worry." Abernethy & White (2) report also that the ascendance scale in Guilford's GAMIN Inventory is significantly associated with laboratory measures of vigor and motility. In both studies paper and pencil measures of self-confidence were shown to be significantly associated with behavioral signs indicating dominance or leadership.

The social trait which has received most attention by far is social sensitivity or empathy. During the year accuracy of perception of one's self and of others has been shown to be related to favorableness toward others [Ausubel & Schiff (9)], to group effectiveness [Fiedler (44); Greer *et al.* (53)], to leadership [Talland (140); Greer *et al.* (53)], and to marital adjustment [Dymond (33)]. Taft (139) has ably surveyed all the literature to date on this subject and concludes that the ability to judge others depends on (a) knowledge of appropriate norms in terms of which the judgment is to be made (including similarity of the judge to the person judged), (b) certain personal ability factors (including intelligence, and possibly a social intelligence factor), and (c) motivation (a desire, both conscious and unconscious, to judge objectively). Gage & Cronbach (49) have, however, raised such serious questions about the methodological procedures followed in a great many of these studies that it seems likely most of the conclusions reached to

date will have to be revised since many of them appear to be based on artifacts of the measuring procedure. One of the most difficult methodological problems to solve lies in the fact that a person who happens to be similar to the persons he is judging can get a high score for accuracy of perception of them simply by filling out the questionnaire or rating schedule as he would answer it. Thus, a high score might result either from a high assumed similarity (social insensitivity) or a really accurate perception of others. It is difficult to disentangle these two types of scores methodologically. Kerr & Sperry (70) report small but significant correlations of their empathy test with a number of validation criteria. They do not explicitly consider how a person is able to get a high score on a test which involves the prediction of the normative responses of groups of people in situations where the norms are already independently and objectively known. Not too surprisingly, people who score high on this test tend to be high in sociometric standing, in sales aptitude, and the like.

In the area of conformity traits Dana (26) has developed a scoring system for detecting abnormalities in the story responses written to TAT cards. He finds that it distinguishes significantly between normals, neurotics, and psychotics. In this respect his approach is similar to Eysenck's (39) in the latter's development of the character interpretation test. In both cases deviant thinking seems to be correlated with deviant adjustment to life. The positive end of this dimension, namely, over-conformity to social norms, does not appear to have been studied during the past year.

Finally, the problem of development of traits has been treated by Schein (119) and by Seward (124) essentially as a problem in learning theory whereas Sanford (117), following the psychoanalytic position, has argued that although certain traits may be developed in this way as a part of normal character development, it is important to distinguish them from other traits which are adopted by the individual to cope with anxiety. Thus, identification as a source of traits is viewed as an example of imitative behavior operating under the influence of reward and punishment according to the first viewpoint, and as a strategy adopted in desperation to handle anxiety, according to the second. The problem of distinguishing operationally between traits developed in these presumably different ways has yet to be solved.

#### SCHEMAS AND VALUES

Dukes (32) has reviewed the traditional values literature which is heavily dependent on a single instrument of measurement, the Allport-Vernon Study of Values. Brown & Lenneberg (16) have suggested an interesting new methodological approach to measuring values in testing the Whorf hypothesis which states that "the more nameable categories are nearer the top of the cognitive 'deck'." While their subject matter deals only with what colors are most salient in this culture, there seems no logical reason why their method could not be applied to discover the salience for individuals of value-terms outside this simple sensory area. Singer (128) has

noted differences in the pattern of stories given to the TAT by subjects of middle and lower class socioeconomic status and has shown how values can be measured by analyses of the spontaneous thought patterns of individuals. This research shows a sensitivity to sociological variables not always present in psychological studies. For example, Freeman & Grayson (47) have drawn conclusions about the characteristics of child-rearing attitudes of mothers of schizophrenics. However, these characteristics may be artifacts attributable to the fact that the mothers of the psychotics are almost certainly of lower socio-economic status than the mothers in their control group.

Perhaps the liveliest methodological controversy of the year developed from the way in which the ideology of the authoritarian personality is described in the literature. Masling (92) has objected that the terms used to describe the authoritarian have been predominantly negative, a form of "mild profanity" in fact, and that they strongly suggest that the person with a high F-scale score must be neurotic whereas the facts show that this need not be the case, at least as shown by ordinary methods of measuring neuroticism. Stotsky (137) lent further support to this argument by demonstrating that while the authors of *The Authoritarian Personality* may not have intended that their description should make the high-scoring person seem "sicker" than the low-scoring person (cf. 48), students after a class discussion of the authoritarian accept the fact that high F-score means neuroticism. When asked to fill out the F-scale as a neurotic would, they project much higher scores into it. Both authors feel that the description of the authoritarian personality has many of the elements of a nonobjective, unfavorable stereotype. Frenkel-Brunswik (48) has replied that while authoritarians may appear better adjusted on the surface, they are in fact more poorly adjusted in terms of their basic adjustment to reality and that we might as well say so. Our value judgments are, of course, the product of our times, she argues; but this fact should not keep us from making such judgments, provided we always have the protection of an objective method of measuring our judgments. The basic issue seems to revolve around whether a psychologist should adopt an absolute or a relativistic and cultural definition of reality. If he should adopt the former view, he might assume, for example, that "this life is what counts" and that therefore anyone who makes adjustments in terms of a projected "life hereafter" is functionally maladjusted to reality. On the other hand, if he should take the relativistic view he might argue that Catholics, for example, are better adjusted to their reality when they take the teachings of their religion seriously enough (a) to judge in terms of the "hereafter," (b) to show unfavorable attitudes toward nonbelievers (note, for example, the realistic complications involved when a devout Catholic marries a Jew), (c) to reject sexual freedom, and (d) generally to show a religious rather than a humanistic orientation toward life. It is not surprising, therefore, that as reported by O'Reilly & O'Reilly (108) and Levinson & Huffman (81) religious people generally score higher on the scales developed by *The Authoritarian Personality* research group, which seems to have

adopted a normative, humanistic framework in defining maladjustment. Even though a psychologist might want to argue that the religious or "other worldly" way of looking at things was basically maladjusted in terms of his definition of reality, he could not, according to the relativistic way of looking at things, regard each individual who accepts the religious system and scores high on the F-scale as maladjusted since the individual might be doing no more than interiorizing in a perfectly normal, reality-oriented way the social reality as it was presented to him. Thus it would seem safer for the scientist not to use terms which imply maladjustment or sickness in describing a person's system of values.

Whatever the outcome of this particular methodological controversy, the fact remains that the "authoritarian" values system has come in for intensive study during the past year. This area of research has been brought into contact with studies of traditional family ideology by Levinson & Huffman (81). A new scale for measuring authoritarianism has been devised by Stagner (133), and O'Neill & Levinson (107) have conducted a factor analysis of several of the scales developed to measure its different aspects. Their research showed that the scales are anything but factorially pure, that they are rather a compound of at least three factors: "religious conventionalism" (or "seriousness" in the terms suggested above), "authoritarian-submission," and "masculine strength façade." Perlmutter (112) and Siegel (125) have independently shown that the extreme highs and extreme lows on the F-scale (the prejudice prone and the prejudice resistant) are in many respects similar. Both highs and lows tend to think in terms of dichotomous stereotypes, the one rejecting most positive characteristics, and the other rejecting most negative characteristics of people. As to correlates of authoritarianism, Jones (65) has shown that in a military setting highs tend to be favorable toward all types of leaders, particularly autocratic ones, and Hollander (59) that highs are themselves rejected as potential leaders, possibly because they are "unable to deal effectively with the needs of others." In these studies and in one by Steiner (135) there is evidence that highs tend to think of the traits of others in more stereotyped terms. It is of interest that Cohn & Karsch (23) report that the mean F-scale score achieved by a group of Germans is higher than any reported in the literature.

Most of the remaining studies in this area have to do with the self-schema. At the simplest level Jourard & Secord (66) have shown that body size in males is a source of self-esteem, and Jahoda (63) has shown that a person's name, at least among the Ashanti, can actually lead to the type of behavior supposedly associated with such a name. The technique of asking a person to sort self-descriptive statements into categories representing degrees of likeness to the real or ideal self has been extensively reported on by Rogers & Dymond [(115); see also Nunnally (103)] as a device for measuring the effects of nondirective therapy. In general it was found that the correlation between the ideal self and the real self increases as the result of psychotherapy. A content analysis of the shifts in actual items showed that ther-



apy results in greater self-understanding, more inner comfort, greater optimism, more self-responsibility, and the like. Landfield (76) and Howard & Kelly (62) used the same *Q*-sort technique for getting self-descriptions and argue that the important variable is not so much the discrepancy between the real and ideal self as it is the perceived change in the self over time. More could be gotten from the *Q*-sort of general theoretical importance for personality theory if it were not conceived simply as an instrument containing items randomly selected to measure the effects of therapy. Osgood & Luria (109) have moved in a somewhat more systematic direction by choosing key concepts in the therapeutic discussion (e.g., "love," "my doctor," "my mother," "sex") and by asking the subject to check on a seven-step scale how close each concept is to either end of 10 bipolar dimensions describing common sensory experiences (e.g., fast and slow, hot and cold, large and small). A factor analysis of the 10 dimensions shows that they involve in the main, three basic factors, one which might be described as evaluation, one as activity, and one as potency. A personal concept can be placed with respect to these three dimensions and its changes can be plotted during the course of therapy. The important point is that this schema represents an attempt to develop a more systematic framework for dealing with concepts related to the self whereas the *Q*-sort technique used by Rogers and associates (103, 115) stresses almost exclusively conflicts between the perceived real and the perceived ideal self. It is interesting to note, however, that if Rogers' emphasis on self-consistency is added to Osgood's on self-evaluation and self-potency, the three basic dimensions of the self-schema described by McClelland (86) are obtained, with the addition of a new dimension from Osgood's schema namely, activity-inactivity which was confounded with potency by McClelland.

As to variables associated with self-perception, Janis (64) has shown that in attitude change studies persons with high self-esteem are more difficult to persuade, Omwake (106) that subjects who accept themselves are more likely to accept others, and Chodorkoff (21) that the more accurately a person describes himself in a *Q*-sort as compared with a judge's *Q*-sort the less perceptual defense he will show to threatening words exposed tachistoscopically. As to variables influencing the self-percept, Epstein (34) reports that schizophrenics overevaluate unrecognized self-expressions more than controls do; and Diller (30) that failure, while it produces no change in overt self-rating, will tend to lower evaluations of unrecognized self-expressions. Conversely, success leads to a rise in overt self-ratings but not in covert.

Another group of studies has attempted to describe the attitude structure of personality in terms of the psychoanalytic theory of psychosexual development using either the Blacky Test [Smock & Thompson (130); Teevan (142)] or a projective-type questionnaire developed by Krout & Tabin (74) and factor analyzed by Stagner *et al.* (134). All of these studies show groupings of attitudes which are consistent with psychoanalytic theory.

For example, disturbances on the Blacky Test in the oral eroticism scale show up more often among humanities undergraduate majors (142); disturbances to Blacky pictures are correlated with disturbances to words signifying the same content as the pictures (130); liking for "giving away toys, clothes, or money" is saturated on the same factor as "tolerance for others' weaknesses," both being hypothesized to reflect the "early anal" stage of psychosexual development (74, 134). Miles (97) has objected to drawing any conclusions about psychosexual etiology from such correlations, since there is no demonstrated connection with actual childhood events. Firm evidence as to the origins of such attitudes would seem to depend on demonstrating an association between actual observations made in childhood and adult personality syndromes shown years later, such as have been reported by Terman (143) in the latest follow-up of his gifted children. Terman reports that hundreds of the variables he measured did not prove to be related to subsequent personality characteristics like occupational choice, and that those that did relate, do not fit readily into any simple scheme. He found, for example, that early weaning was associated with a tendency to go into medicine, and that acting ability and rated conscience and will power as children tended to be associated with a tendency to enter law.

#### MOTIVES

The Taylor Scale of Manifest Anxiety continues to receive a good deal of attention, in part because theorists are split over the possibility, clearly stated by Farber (41), that "manifest anxiety has the functional properties of a drive." Subjects who score high on the Taylor Scale have been shown to have a faster reaction time [Wenar (146)]. And, as Farber's conclusions would suggest, such subjects learn a conditioned eyelid discrimination faster [Spence & Beecroft (131)]. However, they also score higher on a clerical aptitude test which, according to Grice (54), may account for their superior performance on certain complex tasks. Along the same line, Matarazzo *et al.* (94) failed to demonstrate a correlation of the Taylor Scale with academic performance or with untimed intelligence tests. They did, however, obtain a significant negative correlation with a timed test of intelligence, a finding confirmed by Kerrick (71) who found negative correlations with several aptitude measures. Thus, at the present writing, it is not clear whether the relationship of the Taylor Scale to learning is an artifact attributable to its reflection of some ability factor or whether its relation to various ability measures is in turn a function of its drive character. Child's (20) and Kerrick's (71) conclusion that the Taylor Scale seems positively correlated with relatively simple performance tests (e.g., conditioning) and negatively with more complex ones seems justified, although it is not clear exactly how this conclusion fits drive theory. For example, the superior conditionability of anxiety cases and psychotics is explained alternatively by Wishner (149) as being attributable to a less adaptive diffuseness in atten-



tion among neurotics and by Eysenck (37, 40) as the result of lesser production of reactive inhibition in the brain.

Eriksen (35, 36) argues that the Taylor Scale is not so much a direct measure of anxiety as a measure of the way in which anxiety is expressed. His study shows that the scale has a high positive correlation with one type of MMPI anxiety (psychasthenia) and a high negative correlation with another (hysteria). He found, furthermore, that subjects high on the MMPI hysteria scale show greater stimulus generalization to shock than do psychasthenics, suggesting that the former are at least as sensitive in learned responses to an anxiety-producing stimulus as the latter. Taylor & Spence (141) more or less confirm the conclusion that the Taylor Scale is measuring only one form of anxiety by showing that individuals who have been classified as anxiety neurotics by psychiatrists do not score higher on the Taylor Scale nor do they condition faster.

A number of studies have dealt with the question of how generalized anxiety responses are. For example, the Taylor Scale has been shown to have a low positive correlation with number of food aversions [Smith *et al.* (129)] and with overt behavioral signs of anxiety [Kendall (69)]. The Sarason Scale of Manifest Test Anxiety is significantly correlated with general anxiety [Gordon & Sarason (52)] and with Rorschach signs of anxiety, e.g., "subjective, personalized, self-centered response tendencies" as contrasted with more realistic, card-oriented response tendencies [Cox & Sarason (25)]. On the other hand, Lindzey & Newburg (82) found not very encouraging relationships between a number of alleged TAT signs of anxiety and diagnostic ratings of anxiety. The problem here seems to be not to correlate various measures of anxiety endlessly but to determine which ones relate meaningfully to other variables and other types of behavior.

The increased responsiveness of subjects high on the Taylor Scale to threats has been studied by Eriksen (35), by Wenar (146), and by Spence, *et al.* (132) who showed that differences in the speed of eyelid conditioning of female subjects with high and with low Taylor scores were small until shock or threat of shock was introduced. Another study of the relationship between response measures of anxiety and stimulus-induced anxiety was made by Cox & Sarason (25) who found that experimentally induced ego-involvement or threat did not increase Rorschach signs of anxiety. Induced stress (anxiety) has been shown, however, to make perception less efficient [Korchin & Basowitz (73)], to produce greater cognitive rigidity in the *Einstellung* problems [Pally (110)], to induce a greater consistency among levels of aspiration in a variety of tasks [Ausubel & Schiff (8)], and to initiate a "vicious circle" reaction in which knowledge that one is afraid increases fear [Coppock (24)].

Another group of studies has centered on the measurement of human motivation by content analysis of imaginative thought processes. Atkinson *et al.* (7) have reported preliminary findings on measuring the affiliation

motive in this way, and Atkinson (6) has both summarized the considerable body of similar studies on the achievement motive and worked out a general theory of how this method of measuring motivation fits in with an expectancy theory of the nature of learning and perception. McClelland *et al.* (89) have pursued further the origins of the achievement motive in early independence training by demonstrating that certain religious value systems (e.g., Protestant and Jewish) generally favor earlier independence training than do certain others (e.g., Irish- or Italian-Catholic). In parallel fashion, Wright (152) has located the origins of aggression imagery of folktales in severe aggression training for children. Parrish & Rethlingshafer (111) report that they were unable to find the positive correlation between  $n$  Achievement score and school grades occasionally reported previously (88); they raise the important theoretical question of why subjects who have failed in school do not have higher  $n$  Achievement scores the way subjects do who have been made to fail artificially in the classroom. One reason for the difference may be that the achievement-orienting instructions in the classroom may succeed in raising achievement expectations in practically all the subjects whereas the school situation does not, so that some who "flunk out" may not "really fail" in terms of their own frames of reference and hence may not project heightened  $n$  Achievement into their stories.

De Charms *et al.* (27) have raised the question of the relationship between motivation measured indirectly by content analysis of imaginative associations and directly by self-ratings of desire. They explored the behavioral correlates of two such measures of achievement motivation and found that the correlation between them was quite low. They also found that subjects who scored high on self-rating tended to be more influenced by expert authority and to place a lower valuation on people described as unsuccessful, whereas those who scored high on the projective measure of achievement motivation tended generally to perform better in task situations. This finding emphasizes the importance of measuring motivation at both overt and symbolic levels [cf. Leary & Coffey (80)] and suggests that generalizations should be restricted to the method of measurement. Thus when Dennis (29) points out that Hopi children are as overtly competitive in setting goals as are white children, an anthropologist might object that this was not true at the covert or unconscious level, although, in this case, not with too much justification since McClelland *et al.* (88) found the Hopi fairly high in covert achievement motivation. Studies on motivation under hypnosis perhaps also belong here as pointing up the contrast between the effects of unconscious and conscious motivation. Mierke (96) has demonstrated that identical motivational instructions in the waking and hypnotic state produce different work curves on the ergograph because under hypnosis the subject's performance does not appear to feed back and maintain his motivation as it does in the waking state. Fisher (45) was able to fool his subjects into discontinuing a posthypnotic suggestion by acting as if the experiment was all over and discussing the suggestion with the subjects. In this case each sub-

ject's own behavior did feed back and modify the unconscious motive provided the hypnotist restructured the situation so that this was possible.

Extensive studies of more or less conscious motives or interests have been reported by Guilford *et al.* (55) and by Festinger (43). The former factor analyzed a long questionnaire containing items dealing with activities, self-descriptions, and attitudes, both in "I" and "he" form, in an attempt to isolate factors corresponding to some 33 hypothesized needs derived from H. A. Murray's list (cf. 86, Chapter 11) and other sources. In two replications of the study some 17 common factors were located covering such traditional areas as mechanical, scientific, social welfare, and aesthetic interests. The next step would appear to be to demonstrate that some of these factors, if they really represent motives, can be increased or decreased by experimental manipulation and can be shown to be highly correlated with various other behavioral manifestations as demanded by general psychological theory. Festinger (43) has demonstrated the great importance, at least in American subjects, of the need to know exactly where one stands relative to the attitudes and interests of other members of a small group, since there seems to be a "pressure toward uniformity" based on such knowledge.

Nuttin (104) has raised the important methodological question of whether fantasy reflects motivation primarily as a kind of substitute "safety valve" when the motive is blocked in real life, thus making fantasy life an inadequate place to measure motivation in normal people. In support of this notion Feshbach (42) has demonstrated that giving an insulted group of subjects an opportunity to write creative stories (and presumably "blow off steam") will definitely reduce their irritation with the experimenter. On the other hand, Wispé (150) has shown that hunger mobilizes instrumental associations (suggesting the preparatory character of fantasy), and Mussen & Naylor (100) and Holzberg *et al.* (61) have demonstrated a positive correlation between aggression in fantasy and aggressive involvement in real life situations, although in the latter study both too much and too little fantasy aggression are at times associated with aggression disturbance in various laboratory tasks. Furthermore, McKeachie *et al.* (90) have reported a finding which may even throw some doubt on the meaning of the Feshbach study. They demonstrated that the instruction "feel free to comment . . ." on an examination significantly increased grades on the exams, but concluded after several check experiments that it was not the fact that subjects actually abreacted their anxiety by writing comments that improved grades so much as the fact that they felt the instructor to be more favorable toward them. Their anxiety was thus reduced at its source. Consequently, writing TAT's for Feshbach may have reduced irritation not because the subjects worked it off in fantasy, but because the instructions for the TAT (e.g., "feel free to write whatever you like . . .") may have reduced the irritation with the experimenters at its source. But the question of whether associative thought processes are better conceived as preparation

for action or as a substitute for action is still far from settled. Though the situation is not exactly comparable, it is interesting to note that Clark (22) found high covert sexual symbolism to be associated both with low overt sexual imagery (the substitution hypothesis) and also with very high overt sexual symbolism (the preparation hypothesis).

Wispé (150) has shown that an increase in food or water needs will increase the frequency of appearance of need-related responses up to the tenth hour when there is a decrease and that the effect is limited to words signifying instrumental activity rather than satisfaction of the needs. Since Michaux (95) found the same effect with normals but not with schizophrenics, he concludes that the normal control of association by motivation is interfered with by the schizophrenic process. Two studies have demonstrated that increases in motivation tend to "narrow the cognitive map" so that there is less incidental learning [Silverman (127); Bruner *et al.* (17)]. The controversy as to whether needs produce perceptual defense goes on. Goodstein (51) concludes that word recognition thresholds are a function of the relative familiarity of the words and not of their affective value. Brown & Adams (15) maintain the precise opposite, that affective value can operate so strongly as to overcome wide differences in word familiarity. Murdock (99) holds that subjects may be unconsciously responding to the words before they actually "see them." According to Lazarus (78) individual word familiarity may be the mechanism by which needs influence perception. Gilchrist *et al.* (50) found perceptual sensitization to both positive and negative words in a way that makes trouble for anybody's theory! Freeman's (46) data suggest that whether an experimenter finds sensitization or defense seems to depend on what the subjects expect the experimenter is going to show them while Klein's (72) indicate that it depends on the form of cognitive control adopted by the subject.

That greater motive strength generally facilitates performance and learning has been demonstrated again by some of the anxiety studies already referred to (41, 131, 146) and by the demonstration of De Charms *et al.* (27) that projective *n* Achievement correlates positively with performance on certain tasks, a finding confirmed by Wendt (147) who also discovered that the effect seems to be larger for unscheduled than for scheduled tasks. On the other hand, conscious level of aspiration or achievement motivation appears not to be related to performance [Schultz & Ricciuti (122); De Charms *et al.* (27)]. Mierke (96) reports that both the shape and the over-all level of a performance curve are influenced by the type of motive under which the subject is operating. For example, his subjects showed a higher output when they were working for others or for science than when they were working for themselves. Wendt (147) has evidence that one of the mechanisms by which the poorer performance of subjects with low motivation is mediated may be the lowering of central energy or attentiveness as reflected in critical flicker fusion frequency.

Theoretically the field of motivation has been marked by the acceptance,

even by tension reduction theorists like Farber (41) and Myers & Miller (101), of the fact that stimulus increases probably can be reinforcing. Olds' (105) demonstration that electrical stimulation of the limbic area of the brain can be extremely rewarding to a rat would seem to have settled this question. Both Myers & Miller (101) and Nissen (102) have reported further data on certain innate drives, including an exploratory drive, in lower animals. At the human level Maslow has also argued persuasively for "postulating positive per se impulses to satisfy the curiosity, to know, to explain, and to understand" (93, p. 94). The way seems to be opening for bringing pleasure as well as anxiety and its reduction into the theory of motivation.

#### TEXTBOOKS

Two books of readings have appeared, one edited by Brand (14) which is especially good in its selection of different theoretical viewpoints on personality, and one edited by McClelland (87) which attempts to bring together in one place empirical studies of motivation from the clinical, animal-biological, social, and experimental points of view. There have been in addition four books published each of which attempts to describe human personality in terms of a systematic framework: one by Arnold & Gasson (5) from a Catholic point of view, one by Adams (3) from a Lewinian standpoint, one by Rotter (116) in terms of social learning theory, and one by Kelly (68) in terms of what might loosely be called expectancy theory. Since it will take several years to digest the viewpoints expressed in these books, it will be impossible to give here a summary of even the more important ones. If one may be permitted a somewhat superficial generalization, what appears to characterize them all is a strong emphasis on theoretical constructions, with the last three expressed in explicit postulational and definitional form. Facts serve a somewhat secondary confirming or illustrative role, i.e., they do not furnish the hard empirical basis from which one proceeds inductively and very cautiously only to absolutely necessary generalizations. It is clear that Hull's influence has spread in American psychology, and curiously enough the elaborate theoretical constructions it has led to in Kelly's and Rotter's books (68, 116) bring American personality psychology much closer to European characterology than it has been for a long time. However, there still are important methodological differences between the American and European texts.

#### LITERATURE CITED

1. Abernethy, E. M., "The Effect of Sorority Pressures on the Results of a Self-inventory," *J. Social Psychol.*, **40**, 177-83 (1954)
2. Abernethy, E. M., and White, J. C., Jr., "Correlations of a Self-inventory of Personality Traits with Laboratory Measures of Vigor and Motility," *J. Social Psychol.*, **40**, 185-88 (1954)
3. Adams, D. K., *The Anatomy of Personality* (Doubleday & Co., Inc., Garden City, N. Y., 44 pp., 1954)
4. Applezweig, D. G., "Some Determinants of Behavioral Rigidity," *J. Abnormal Social Psychol.*, **49**, 224-28 (1954)

5. Arnold, M. B., and Gasson, J. A., Eds., *The Human Person* (The Ronald Press Co., New York, N. Y., 593 pp., 1954)
6. Atkinson, J. W., "Exploration Using Imaginative Thought to Assess the Strength of Human Motives," in *Nebraska Symposium on Motivation 1954*, 56-112 (Jones, M. R., Ed., University of Nebraska Press, Lincoln, Neb., 322 pp., 1954)
7. Atkinson, J. W., Heyns, R. W., and Veroff, J., "The Effect of Experimental Arousal of the Affiliation Motive on Thematic Apperception," *J. Abnormal Social Psychol.*, **49**, 405-10 (1954)
8. Ausubel, D. P., and Schiff, H. M., "A Level of Aspiration Approach to the Measurement of Goal Tenacity," *J. Gen. Psychol.*, **52**, 97-110 (1955)
9. Ausubel, D. P., and Schiff, H. M., "Some Intra-personal and Interpersonal Determinants of Individual Differences in Sociopathic Ability among Adolescents," *J. Social Psychol.*, **41**, 39-56 (1955)
10. Bandura, A., "The Rorschach White Space Response and Perceptual Reversal," *J. Exptl. Psychol.*, **48**, 113-18 (1954)
11. Barron, F., *Personal Soundness in University Graduate Students* (University of California Publications, Personality Assessment and Research, Berkeley, Calif., 32 pp., 1954)
12. Barron, F., "Threshold for the Perception of Human Movement in Inkblots," *J. Consulting Psychol.*, **19**, 33-38 (1955)
13. Becker, W. C., "Perceptual Rigidity as Measured by Aniseikonic Lenses," *J. Abnormal Social Psychol.*, **49**, 419-22 (1954)
14. Brand, H., Ed., *The Study of Personality* (John Wiley & Sons, Inc., New York, N. Y., 581 pp., 1954)
15. Brown, D. R., and Adams, J., "Word Frequency and the Measurement of Value Areas," *J. Abnormal Social Psychol.*, **49**, 427-30 (1954)
16. Brown, R. W., and Lenneberg, E. H., "A Study in Language and Cognition," *J. Abnormal Social Psychol.*, **49**, 454-62 (1954)
17. Bruner, J. S., Matter, J., and Papanek, M. L., "Breadth of Learning as a Function of Drive Level and Mechanization," *Psychol. Rev.*, **62**, 1-10 (1955)
18. Cattell, R. B., Dubin, S. S., and Saunders, D. R., "Verification of Hypothesized Factors in One Hundred and Fifteen Objective Personality Designs," *Psychometrika*, **19**, 209-30 (1954)
19. Cattell, R. B., and Stice, G. F., "Four Formulae for Selecting Leaders on the Basis of Personality," *Human Relations*, **7**, 493-507 (1954)
20. Child, I. L., "Personality," *Ann. Rev. Psychol.*, **5**, 149-70 (1954)
21. Chodorkoff, B., "Self-perception, Perceptual Defense, and Adjustment," *J. Abnormal Social Psychol.*, **49**, 508-12 (1954)
22. Clark, R. A., "The Effects of Sexual Motivation on Phantasy," in *Studies in Motivation*, 44-57 (McClelland, D. C., Ed., Appleton-Century-Crofts, Inc., New York, N. Y., 552 pp., 1955)
23. Cohn, T. S., and Karsch, H., "Administration of the F-scale to a Sample of Germans," *J. Abnormal Social Psychol.*, **49**, 471 (1954)
24. Coppock, H. W., "Responses of Subjects to their own Galvanic Skin Responses," *J. Abnormal Social Psychol.*, **50**, 25-28 (1955)
25. Cox, F. N., and Sarason, S. B., "Test Anxiety and Rorschach Performance," *J. Abnormal Social Psychol.*, **49**, 371-77 (1954)
26. Dana, R. H., "Clinical Diagnosis and Objective TAT Scoring," *J. Abnormal Social Psychol.*, **50**, 19-24 (1955)

27. De Charms, R., Morrison, H. W., Reitman, W., and McClelland, D. C., "Behavioral Correlates of Directly and Indirectly Measured Achievement Motivation," in *Studies in Motivation*, 414-23 (McClelland, D. C., Ed., Appleton-Century-Crofts, Inc., New York, N. Y., 552 pp., 1955)
28. de Groot, A. D., "Scientific Personality Diagnosis," *Acta Psychol.*, **10**, 220-41 (1954)
29. Dennis, W., "Are Hopi Children Non-competitive?," *J. Abnormal Social Psychol.*, **50**, 99-100 (1955)
30. Diller, L., "Conscious and Unconscious Self-attitudes after Success and Failure," *J. Personality*, **23**, 1-12 (1954)
31. Doane, B. K., "A Factorial Study of Integration," *Can. J. Psychol.*, **8**, 61-69 (1954)
32. Dukes, W. F., "Psychological Studies of Values," *Psychol. Bull.*, **52**, 24-50 (1955)
33. Dymond, R., "Interpersonal Perception and Marital Happiness," *Can. J. Psychol.*, **8**, 164-71 (1954)
34. Epstein, S., "Unconscious Self-evaluation in a Normal and a Schizophrenic Group," *J. Abnormal Social Psychol.*, **50**, 65-70 (1955)
35. Eriksen, C. W., "Some Personality Correlates of Stimulus Generalizations under Stress," *J. Abnormal Social Psychol.*, **49**, 561-65 (1954)
36. Eriksen, C. W., and Davids, A., "The Meaning and Clinical Validity of the Taylor Anxiety Scale and the Hysteria-Psychesthesia Scales from the MMPI," *J. Abnormal Social Psychol.*, **50**, 135-37 (1955)
37. Eysenck, H. J., "Abord Statistique et Experimental du Problème Typologique dans la Personnalité Nevrotique, Psychotique et Normale," *L'Evolution Psychiat.*, **3**, 377-404 (1954)
38. Eysenck, H. J., *A Dynamic Theory of Anxiety and Hysteria* (Institute of Psychiatry, Maudsley Hospital, London, England, 41 pp., 1954)
39. Eysenck, H. J., "Probleme der diagnostischen Untersuchung und Demonstration des Charakter-Interpretationstestes," *Z. Exptl. Angew. Psychol.*, **2**, 1-32 (1954)
40. Eysenck, H. J., "Zur Theorie der Persönlichkeitsmessung," *Z. Diagnostische Psychol. u. Persönlichkeitsforsch.*, **2**, 87-101, 171-87 (1954)
41. Farber, I. E., "Anxiety as a Drive State," in *Nebraska Symposium on Motivation 1954*, 1-46 (Jones, M. R., Ed., University of Nebraska Press, Lincoln, Neb., 322 pp., 1954)
42. Feshbach, S., "The Drive-reducing Function of Fantasy Behavior," *J. Abnormal Social Psychol.*, **50**, 3-11 (1955)
43. Festinger, L., "Motivation Leading to Social Behavior," in *Nebraska Symposium on Motivation 1954*, 191-219 (Jones, M. R., Ed., University of Nebraska Press, Lincoln, Neb., 322 pp., 1954)
44. Fiedler, F. E., "Assumed Similarity Measures as Predictors of Team Effectiveness," *J. Abnormal Social Psychol.*, **49**, 381-87 (1954)
45. Fisher, S., "The Role of Expectancy in the Performance of Posthypnotic Behavior," *J. Abnormal Social Psychol.*, **49**, 503-7 (1954)
46. Freeman, J. T., "Set or Perceptual Defense?," *J. Exptl. Psychol.*, **48**, 283-88 (1954)
47. Freeman, R. V., and Grayson, H. M., "Maternal Attitudes in Schizophrenia," *J. Abnormal Social Psychol.*, **50**, 45-52 (1955)



48. Frenkel-Brunswick, E., "Social Research and the Problem of Values: a Reply," *J. Abnormal Social Psychol.*, **49**, 466-71 (1954)
49. Gage, N. L., and Cronbach, L. J., *Conceptual and Methodological Problems in Interpersonal Perception* (Bureau Education Research, University of Illinois, Urbana, Ill., 19 pp., 1954)
50. Gilchrist, J. C., Ludeman, J. F., and Lysak, W., "Values as Determinants of Word-recognition Thresholds," *J. Abnormal Social Psychol.*, **49**, 423-26 (1954)
51. Goodstein, L. D., "Affective Tone and Visual Recognition Thresholds," *J. Abnormal Social Psychol.*, **49**, 443-44 (1954)
52. Gordon, E. M., and Sarason, S. B., "The Relationship between 'Test Anxiety' and 'Other Anxieties,'" *J. Personality*, **23**, 317-23 (1955)
53. Greer, F. L., Galanter, E. H., and Nordlie, P. G., "Interpersonal Knowledge and Individual and Group Effectiveness," *J. Abnormal Social Psychol.*, **49**, 411-14 (1954)
54. Grice, G. R., "Discrimination Reaction Time as a Function of Anxiety and Intelligence," *J. Abnormal Social Psychol.*, **50**, 71-74 (1955)
55. Guilford, J. P., Christensen, P. R., Bond, N. A., Jr., and Sutton, M. A., "A Factor Analysis Study of Human Interests," *Psychol. Monographs*, **68**(4), 1-38 (1954)
56. Hamlin, R. M., "The Clinician as Judge: Implications of a Series of Studies," *J. Consulting Psychol.*, **18**, 233-38 (1954)
57. Heron, A., "The Objective Measurement of Personality among Factory Workers," *J. Social Psychol.*, **39**, 161-85 (1954)
58. Hertzka, A. F., Guilford, J. P., Christensen, P. R., and Berger, R. M., "A Factor Analytic Study of Evaluative Abilities," *Educ. Psychol. Measurement*, **14**, 581-97 (1954)
59. Hollander, E. P., "Authoritarianism, and Leadership Choice in a Military Setting," *J. Abnormal Social Psychol.*, **49**, 365-70 (1954)
60. Holtzman, W. H., and Sells, S. B., "Prediction of Flying Success by Clinical Analysis of Test Protocols," *J. Abnormal Social Psychol.*, **49**, 485-90 (1954)
61. Holzberg, J. D., Bursten, B., and Santiccioli, A., "The Reporting of Aggression as an Indication of Aggressive Tension," *J. Abnormal Social Psychol.*, **50**, 12-18 (1955)
62. Howard, A. R., and Kelly, G. A., "A Theoretical Approach to Psychological Movement," *J. Abnormal Social Psychol.*, **49**, 399-404 (1954)
63. Jahoda, G., "A Note on Ashanti Names and Their Relationship to Personality," *Brit. J. Psychol.*, **45**, 192-95 (1954)
64. Janis, I., "Personality Correlates of Susceptibility to Persuasion," *J. Personality*, **22**, 504-18 (1954)
65. Jones, E. E., "Authoritarianism as a Determinant of First-impression Formation," *J. Personality*, **23**, 107-27 (1954)
66. Jourard, S. M., and Secord, P. F., "Body Size and Body-cathexis," *J. Consulting Psychol.*, **18**, 184 (1954)
67. Keehn, J. D., "A Factorial Study of Tests of Color-form Attitudes," *J. Personality*, **23**, 295-307 (1955)
68. Kelly, G. A., *The Psychology of Personal Constructs, I, A Theory of Personality* (W. W. Norton & Co., Inc., New York, N. Y., 556 pp., 1955)
69. Kendall, E., "The Validity of Taylor's Manifest Anxiety Scale," *J. Consulting Psychol.*, **18**, 429-32 (1954)



70. Kerr, W. A., and Speroff, B. J., "Validation and Evaluation of the Empathy Test," *J. Gen. Psychol.*, **50**, 269-76 (1954)
71. Kerrick, J. S., "Some Correlates of the Taylor Manifest Anxiety Scale," *J. Abnormal Social Psychol.*, **50**, 75-77 (1955)
72. Klein, G. N., "Need and Regulation," in *Nebraska Symposium on Motivation 1954*, 224-74 (Jones, M. R., Ed., University of Nebraska Press, Lincoln, Neb., 322 pp., 1954)
73. Korchin, S. J., and Basowitz, A., "Perceptual Adequacy in a Life Stress," *J. Psychol.*, **38**, 495-502 (1954)
74. Krout, M. H., and Tabin, J. K., "Measuring Personality in Developmental Terms: the P.P.S.," *Genet. Psychol. Monographs*, **50**, 289-335 (1954)
75. Kurtz, J. C., and Riggs, M. M., "An Attempt to Influence the Rorschach Test by Means of a Peripheral Set," *J. Consulting Psychol.*, **18**, 465-70 (1954)
76. Landfield, A. W., "A Movement Interpretation of Threat," *J. Abnormal Social Psychol.*, **49**, 529-32 (1954)
77. Lane, J. E., "Social Effectiveness and Developmental Level," *J. Personality*, **23**, 274-84 (1955)
78. Lazarus, R. S., "Is there a Mechanism of Perceptual Defense: a Reply to Postman, Bronson, and Gropper," *J. Abnormal Social Psychol.*, **49**, 396-98 (1954)
79. Lazarus, R. S., and Oldfield, M., "Rorschach Responses and the Influence of Color," *J. Personality*, **23**, 356-72 (1955)
80. Leary, T., and Coffey, H. S., "Interpersonal Diagnosis: Some Problems of Methodology and Validation," *J. Abnormal Social Psychol.*, **50**, 110-24 (1955)
81. Levinson, D. J., and Huffman, P. E., "Traditional Family Ideology and its Relation to Personality," *J. Personality*, **23**, 251-73 (1955)
82. Lindzey, G., and Newburg, A. S., "Thematic Apperception Test: a Tentative Appraisal of some 'Signs' of Anxiety," *J. Consulting Psychol.*, **18**, 389-95 (1954)
83. Little, K. B., and Shneidman, E. S., "The Validity of Thematic Projective Technique Interpretations," *J. Personality*, **23**, 285-94 (1955)
84. Lofchie, S. H., "The Performance of Adults Under Distraction Stress: a Developmental Approach," *J. Psychol.*, **39**, 109-16 (1955)
85. MacArthur, R. S., "An Experimental Investigation of Persistence in Secondary School Boys," *Can. J. Psychol.*, **9**, 42-54 (1955)
86. McClelland, D. C., *Personality* (William Sloane Associates, New York, N. Y., 654 pp., 1951)
87. McClelland, D. C., Ed., *Studies in Motivation* (Appleton-Century-Crofts, Inc., New York, N. Y., 552 pp., 1955)
88. McClelland, D. C., Atkinson, J. W., Clark, R. A., and Lowell, E. L., *The Achievement Motive* (Appleton-Century-Crofts, Inc., New York, N. Y., 384 pp., 1953)
89. McClelland, D. C., Rindlisbacher, A., and De Charms, R., "Religious and Other Sources of Parental Attitudes Toward Independence Training," in *Studies in Motivation*, 389-97 (McClelland, D. C., Ed., Appleton-Century-Crofts, Inc., New York, N. Y., 552 pp., 1955)
90. McKeachie, W. J., Pollie, D., and Speisman, J., "Relieving Anxiety in Classroom Examinations," *J. Abnormal Social Psychol.*, **50**, 93-100 (1955)
91. Martin, B., "Intolerance of Ambiguity in Interpersonal and Perceptual Behavior," *J. Personality*, **22**, 494-503 (1954)

92. Masling, J. M., "How Neurotic is the Authoritarian?," *J. Abnormal Social Psychol.*, **49**, 316-18 (1954)
93. Maslow, A. H., *Motivation and Personality* (Harper & Brothers, New York, N. Y., 411 pp., 1954)
94. Matarazzo, J. D., Ulett, G. A., Guze, S. B., and Saslow, G., "The Relationship Between Anxiety Level and Several Measures of Intelligence," *J. Consulting Psychol.*, **18**, 201-5 (1954)
95. Michaux, W., "Schizophrenic Apperception as a Function of Hunger," *J. Abnormal Social Psychol.*, **50**, 53-58 (1955)
96. Mierke, K., "Direktions- und Motivationskräfte im Leistungsvollzug," *Z. Exptl. Angew. Psychol.*, **2**, 92-135 (1954)
97. Miles, D. W., "The Import for Clinical Psychology of the Use of Tests Derived from Theories about Infantile Sexuality and Adult Character," *Genet. Psychol. Monographs*, **50**, 227-88 (1954)
98. Mooney, C. M., "A Factorial Study of Closure," *Can. J. Psychol.*, **8**, 51-60 (1954)
99. Murdock, B. B., "Perceptual Defense and Threshold Measurements," *J. Personality*, **22**, 565-71 (1954)
100. Mussen, P. H., and Naylor, H. K., "The Relationships Between Overt and Fantasy Aggression," *J. Abnormal Social Psychol.*, **49**, 235-40 (1954)
101. Myers, A. K., and Miller, N. E., "Failure to Find a Learned Drive Based on Human Evidence for Learning Motivated by 'Exploration,'" *J. Comp. Physiol. Psychol.*, **6**, 428-36 (1954)
102. Nissen, H. W., "The Nature of Drive as Innate Determinant of Behavioral Organization," in *Nebraska Symposium on Motivation 1954*, 281-321 (Jones, M. R., Ed., University of Nebraska Press, Lincoln, Neb., 322 pp., 1954)
103. Nunnally, J. C., "An Investigation of Some Propositions of Self-conception: the Case of Miss Sun," *J. Abnormal Social Psychol.*, **50**, 87-92 (1955)
104. Nuttin, J., "Personality," *Ann. Rev. Psychol.*, **6**, 161-86 (1955)
105. Olds, J., "A Physiological Study of Reward," in *Studies in Motivation*, 134-43 (McClelland, D. C., Ed., Appleton-Century-Crofts, Inc., New York, N. Y., 552 pp., 1955)
106. Omwake, K. T., "The Relation Between Acceptance of Self and Acceptance of Others Shown by Three Personality Inventories," *J. Consulting Psychol.*, **18**, 443-46 (1954)
107. O'Neil, W. M., and Levinson, D. J., "A Factorial Exploration of Authoritarianism and Some of its Ideological Concomitants," *J. Personality*, **22**, 449-63 (1954)
108. O'Reilly, C. T., and O'Reilly, E. J., "Religious Beliefs of Catholic College Students and Their Attitudes Toward Minorities," *J. Abnormal Social Psychol.*, **49**, 378-80 (1954)
109. Osgood, C. E., and Luria, Z., "A Blind Analysis of a Case of Multiple Personality Using the Semantic Differential," *J. Abnormal Social Psychology*, **49**, 579-91 (1954)
110. Pally, S., "Cognitive Rigidity as a Function of Threat," *J. Personality*, **23**, 346-55 (1955)
111. Parrish, J., and Rethlingshafer, D., "A Study of the Need to Achieve in College Achievers and Non-achievers," *J. Gen. Psychol.*, **50**, 209-26 (1954)
112. Perlmutter, H. V., "Some Characteristics of the Xenophilic Personality," *J. Psychol.*, **38**, 291-300 (1954)

113. Rabin, A., Nelson, W., and Clark, M., "Rorschach Content as a Function of Perceptual Experience and Sex of the Examiner," *J. Clin. Psychol.*, **10**, 188-90 (1954)
114. Rim, Y., "Perseveration and Fluency as Measures of Introversion-extraversion in Abnormal Subjects," *J. Personality*, **23**, 324-34 (1955)
115. Rogers, C. R., and Dymond, R. F., *Psychotherapy and Personality Change* (University of Chicago Press, Chicago, Ill., 447 pp., 1954)
116. Rotter, J. B., *Social Learning and Clinical Psychology* (Prentice-Hall, Inc., New York, N. Y., 466 pp., 1954)
117. Sanford, N., "The Dynamics of Identification," *Psychol. Rev.*, **62**, 106-18 (1955)
118. Scheier, I. H., "An Evaluation of Rigidity Factors," *Can. J. Psychol.*, **8**, 157-63 (1954)
119. Schein, E. H., "The Effect of Reward on Adult Imitative Behavior," *J. Abnormal Social Psychol.*, **49**, 389-95 (1954)
120. Schick, C. P., "Die Axiomatischen Systeme von Kretschmer und Eysenck," *Z. Exptl. Angew. Psychol.*, **2**, 552-74 (1954)
121. Schmidt, H. O., Fonda, C. P., and Wesley, E. L., "A Note on Consistency of Rigidity as a Personality Variable," *J. Consulting Psychol.*, **18**, 450 (1954)
122. Schultz, D. G., and Ricciuti, H. N., "Level of Aspiration Measures and College Achievement," *J. Gen. Psychol.*, **51**, 185-92 (1954)
123. Secord, P. F., "Personality Integration in Response to Self-inventories," *J. Personality*, **23**, 308-16 (1955)
124. Seward, J. P., "Learning Theory and Identification: II. The Role of Punishment," *J. Genet. Psychol.*, **84**, 201-10 (1954)
125. Siegel, S., "Certain Determinants and Correlates of Authoritarianism," *Genet. Psychol. Monographs*, **49**, 187-229 (1954)
126. Siipola, E. M., "The Influence of Color on Reactions to Inkblots," *J. Personality*, **18**, 358-82 (1950)
127. Silverman, R. E., "Anxiety and the Mode of Response," *J. Abnormal Social Psychol.*, **49**, 538-42 (1954)
128. Singer, J. L., "Projected Familial Attitudes as a Function of Socioeconomic Status and Psychopathology," *J. Consulting Psychol.*, **18**, 99-104 (1954)
129. Smith, W., Powell, E. K., and Ross, S., "Manifest Anxiety and Food Aversions," *J. Abnormal Social Psychol.*, **50**, 101-4 (1955)
130. Smock, C. D., and Thompson, G. G., "An Inferred Relationship Between Early Childhood Conflicts and Anxiety Responses in Adult Life," *J. Personality*, **23**, 88-98 (1954)
131. Spence, K. W., and Beecroft, R. S., "Differential Conditioning and Level of Anxiety," *J. Exptl. Psychol.*, **48**, 399-403 (1954)
132. Spence, K. W., Farber, I. E., and Taylor, E., "The Relation of Electric Shock and Anxiety to Level of Performance in Eyelid Conditioning," *J. Exptl. Psychol.*, **48**, 404-8 (1954)
133. Stagner, R., "Attitude Toward Authority: an Exploratory Study," *J. Social Psychol.*, **40**, 197-210 (1954)
134. Stagner, R., Lawson, E. D., and Moffitt, J. W., "The Krout Personal Preference Scale: a Factor Analytic Study," *J. Clin. Psychol.*, **11**, 103-13 (1955)
135. Steiner, I. D., "Ethnocentrism, and Tolerance of Trait 'Inconsistency,'" *J. Abnormal Social Psychol.*, **49**, 349-54 (1954)
136. Stewart, L. H., "The Expression of Personality in Drawings and Paintings," *Genet. Psychol. Monographs*, **51**, 45-103 (1955)

137. Stotsky, B. A., "The Authoritarian Personality as a Stereotype," *J. Psychol.*, **39**, 325-28 (1955)
138. Sundberg, N. D., "The Acceptability of 'Fake' Versus 'Bona Fide' Personality Test Interpretations," *J. Abnormal Social Psychol.*, **50**, 145-47 (1955)
139. Taft, R., "The Ability to Judge People," *Psychol. Bull.*, **52**, 1-23 (1955)
140. Talland, G. A., "The Assessment of Group Opinion by Leaders, and Their Influence on its Formation," *J. Abnormal Social Psychol.*, **49**, 431-34 (1954)
141. Taylor, J. A., and Spence, K. W., "Conditioning Level in the Behavior Disorders," *J. Abnormal Social Psychol.*, **49**, 497-502 (1954)
142. Teevan, R. C., "Personality Correlates of Undergraduate Field of Specialization," *J. Consulting Psychol.*, **18**, 212-18 (1954)
143. Terman, L. M., "Scientists and Nonscientists in a Group of 800 Gifted Men," *Psychol. Monographs*, **68**(7), 1-44 (1954)
144. Wellek, A., "Der Stand der psychologischen Diagnostik im Überblick," *Studium Generale*, **8**, 464-72 (1954)
145. Wellek, A., "Beiträge zu einer Strukturtheorie der Hypnose," *Psychol. Rundschau*, **6**, 33-50 (1955)
146. Wenar, C., "Reaction Time as a Function of Manifest Anxiety and Stimulus Intensity," *J. Abnormal Social Psychol.*, **49**, 335-40 (1954)
147. Wendt, H. W., "Motivation, Effort, and Performance," in *Studies in Motivation*, 448-59 (McClelland, D. C., Ed., Appleton-Century-Crofts, Inc., New York, N. Y., 552 pp., 1955)
148. Wilson, R. C., Guilford, J. P., Christensen, P. R., and Lewis, D. J., "A Factor-analytic Study of Creative Thinking Abilities," *Psychometrika*, **19**, 297-311 (1954)
149. Wishner, J., "The Concept of Efficiency in Psychological Health and in Psychopathology," *Psychol. Rev.*, **62**, 69-80 (1955)
150. Wispé, L. G., "Physiological Need, Verbal Frequency, and Word Association," *J. Abnormal Social Psychol.*, **49**, 229-34 (1954)
151. Wolff, W., "Certainty: Generality and Relation to Manifest Anxiety," *J. Abnormal Social Psychol.*, **50**, 59-64 (1955)
152. Wright, G. O., "Projection and Displacement: a Cross-cultural Study of Folk-tale Aggression," *J. Abnormal Social Psychol.*, **49**, 523-28 (1954)
153. Zubin, J., "Current Theoretical and Practical Problems in Measurement: a Symposium. The Measurement of Personality," *J. Counseling Psychol.*, **1**, 159-64 (1954)
154. Zubin, J., "Failures of the Rorschach Technique," *J. Projective Techniques*, **18**, 303-15 (1954)

## SOCIAL PSYCHOLOGY AND GROUP PROCESSES<sup>1</sup>

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During the past year social psychology probably set a new output record. At any rate the bibliography of this review exceeds that of any previous annual review of the field, and this despite the exclusion of almost half of the articles read.

A major event of the year was the publication of the *Handbook of Social Psychology* edited by Lindzey (87), a massive (two volumes, 1226 pages) and on the whole a very well drawn portrait of social psychology as it is today. Even a very superficial comparison with Murchison's 1935 *Handbook* (95) is most instructive with respect to changes in the field over the last 20 years. Murchison's volume had almost as many pages (1195), but they were smaller, and about three quarters of them were devoted to topics of scant concern to Lindzey, i.e., the social behavior of animals, together with various other topics considered nowadays to be more strictly anthropological, sociological, or psychological in character. The chapters on attitudes and on the effects of social situations on individuals come closest to social psychology as it is conceived today, but even here the orientation was rather different and the available information much less extensive. The most striking advances highlighted by Lindzey's *Handbook* involve methodology, group processes, and applications of social psychology. Space is not available here to review these properly, or even to list the chapter titles. Suffice it to say that the new handbook makes it clear that social psychology has come a long way, not just in terms of numbers of studies performed, articles published, or facts known, but also in terms of the understandings (i.e., hypotheses) derivable from an accumulation of carefully established facts. Although it is probably true, as many critics maintain, that social psychology now stands in greater need of theory than of facts, still it does begin to look as if a good deal of coherence and explanatory power has already been achieved, and, further, as if empiricists had largely made this possible.

That further progress is rapidly being made in the direction of greater coherence and structure in the field is suggested by consideration of the original research of the past year. The increase in emphasis on group behavior attested by a comparison of Murchison and Lindzey has progressed far enough that this area begins to provide a central focus for the entire field. Not only do group phenomena already recognized as such claim more

<sup>1</sup> This review covers the period between May 1, 1954 and May 1, 1955.

<sup>2</sup> The opinions or conclusions contained in the chapter are those of the author. They are not to be construed as reflecting the views or indorsement of the Department of the Air Force.

attention, but studies in other areas, e.g., voting behavior, are oriented to a greater extent toward concepts of interaction and group process. Within this growing central area, furthermore, some small-scale theories developed in recent years are being extended to encompass wider ranges of phenomena, and there is a proliferation of interesting and useful mathematical models. This theoretical activity, combined with growing methodological sophistication, should result in a progressive increase in the frequency of important experiments which add up to something.

#### ATTITUDE AND OPINION METHODOLOGY

Of the various areas of explicit methodological inquiry, that concerned with attitudes and opinions undoubtedly continues to be the most active, although some questions of long standing are beginning to be resolved.

*Methods of data collection.*—"It seems likely that sampling is no longer a key problem in opinion polling." So conclude Kilpatrick & Garard (75) after presenting results of polls conducted in Trenton by Princeton classes in 1952 and 1953. The two polls were taken about two weeks before election time, using block samples of 300 and 280, respectively, from the total population of about 127,000 with stratification for age and sex. Errors ranged from 0.3 per cent in the 1952 presidential election to 1.7 per cent in the 1953 vote on the "veterans' widows tax exemption" referendum. The authors attribute their success not only to the use of sound sampling procedures but also to the fact that the interviewers were intelligent, well motivated, and well supervised and trained.

That sampling may no longer be a key problem is perhaps implied also by the small amount of attention given this topic during the past year. Just two additional articles have been noted, both concerned with mail questionnaires. Wallace (147) reports results suggesting that in the general population there are sizeable numbers of habitual "repliers" and of habitual "nonrepliers," the two groups evidently being different with respect to education and other traits. If the investigator is dealing with homogeneous segments of the population, or with topics unrelated to the distinctive features of repliers, it obviously follows that mail samples may involve little bias. Waisanen (146) found that with a small sample responses to a mailed questionnaire were almost doubled as a result of a preliminary telephone call requesting co-operation of the respondent. No data are presented, however, with respect to the effects of this procedure on sample representativeness.

Errors incident to conventional interview procedures occupied a number of investigators. Bennett, Blomquist & Goldstein (13) examined the consistency with which a sample of college students answered 30 limited-response questions on two occasions separated by a four-week interval. Mean stability coefficients were very high for items of "sociological information" (e.g., sex, religion), somewhat less high for questions of past behavior and of knowledge, and lowest for attitude items. As the authors recognized, some of the instability exhibited over this time period may reflect actual changes

rather than measurement error. However, in a further study Bennett, Alpert & Goldstein (12) found for the same four categories of items an essentially similar gradient in consistency between the subject's response to the item and the investigators' prediction of his response based on an hour's interview immediately preceding the subject's completion of the questionnaire.

Withey (156) on two occasions one year apart obtained reports of individual income for the year preceding the interview and analyzed these in relation to the figure recalled by the respondent on the second occasion as describing his income during the first of the two years. He found that errors in recall were generally in the direction of reported income change over the year period.

Ordinal position effects in selection of items from a check list were studied by Becker (11), who replicated an earlier study by Campbell & Mohr (25) which had failed to find such effects. However, instead of using college students, as had Campbell & Mohr, Becker employed a stratified-random sample of adults interviewed individually in their homes. Comparability to the usual conditions of survey research was further insured by burying the check list among other types of questions. Under these conditions, Becker hypothesized, there should be a definite order effect favoring earlier items, and this is exactly what Becker obtained.

Guest (52) found that interviewer errors and variability in results obtained by different interviewers were reduced by giving interviewers practice in interviewing, in addition to the usual explanation of the schedule, and that a still further reduction in errors resulted from giving interviewers practice in coding. The samples were small, however, and these very plausible differences not significant statistically.

An article by Getzels (44) proposes a conceptual framework for analysis of the question-answer process. In essentials Getzels sees this as a process of interaction, in which the respondent's answer represents a suitable compromise between his actual opinion and his perception of the requirements of the immediate situation. Previous results concerning interview errors are considered in light of this formulation, and further specific hypotheses are proposed for empirical test. Probably no recent earth tremors of any size can be traced to Getzels' article, but in an area dominated by technicians and practitioners even the modest impact of a modest theory is worth recording.

Several departures from conventional interviewing have been reported. Perrine & Wessman (102) describe the effectiveness of disguised interviews with 214 people in predicting the outcome of a state election in a New Jersey county having a population of about 400,000. These interviews took the form of casual conversations with people encountered by chance and selected to fill specified quotas. No errors of prediction larger than 4.0 per cent were obtained, but the authors' observations suggest certain limitations in this approach in the case of certain classes of respondents, e.g., persons differing from the interviewer in sex or race. Hare & Davie (58) report that a series



of "bull session"-type interviews with groups of undergraduates quickly yielded a valid picture of undergraduate culture, but the authors freely admit the largely subjective nature of this evaluation. One might suppose that a picture of the culture's norms would indeed be obtainable in this manner, while the extent of variation in attitude might not be so readily apparent as a result of operation of pressures to conformity. Chandler (27) presents some observations suggesting that this is the case and that the group interview is especially valuable as a supplement to individual interviews.

Data obtained by participant observers are discussed by Vidich & Shapiro (145), who show that the contacts made by one participant observer were biased by his sex and status, but that there was definite correspondence between his description of the status structure of the community and the picture obtained by survey techniques, and that the observer's report helped greatly in the interpretation of survey results. Another empirical look at a basic anthropological device was taken by Campbell (24), who found that ratings of the morale of various submarine crews by informants on the squadron staff correlated highly with morale measures obtained from crew members and that enlisted staff personnel were somewhat more accurate than officers in making such appraisals.

*Attitude structure and scaling techniques.*—One of the more interesting developments in the attitude area is a paper by Guttman (56) discussing the psychological interpretation of the principal components of attitude scale analysis which he described mathematically in *Measurement and Prediction* (55). It will be recalled in the case of a perfect scale that, plotted against the original scale scores, the first component is a monotonic function of the scale scores, the second is a U-shaped one, the third shows two inflections, the fourth three inflections, and so on. The first component represents, of course, the negative-neutral-positive (content) dimension, and the second component Guttman has long identified as intensity. Guttman's new analysis deals primarily with the third and fourth components. The third component, treated briefly in an earlier paper (54), he calls "closure," meaning the degree of definiteness with which the individual is or is not committed to one or more of the positive alternatives available to him.

The data which first suggested this interpretation were obtained in a study of the postwar plans of Israeli soldiers. A scale of the definiteness with which they had made some plan was constructed and related to scales of attitude toward each of a variety of specific plans. Each regression showed essentially a double inflection suggestive of the third component, and additional samples confirmed this result. Of interest also was the finding that a high proportion of respondents was extremely negative both on the closure scale (i.e., they were quite certain they had no positive plan) and on attitude toward remaining in the Army. This combination, which did not appear with other possible plans, Guttman interprets as prejudice.

This interpretation suggested in turn a possible interpretation of the fourth component, i.e., a function which would encompass an unreasoning

attitude that might conceivably be extremely positive or neutral as well as extremely negative. Guttman reasoned that such attitudes might be expected where the individual was little involved with a given object, whereas high involvement should be associated with moderately positive or negative attitudes. As an empirical test, measures of attitude toward the Voice of Israel were related to independent scales of involvement or interest in the Voice. The resulting regression took the predicted form and led to naming the fourth component "involution."

Guttman's interpretations are, of course, in the nature of hypotheses which demand considerably more supporting evidence. It is obviously not necessary that the mathematical components have psychological meaning, i.e., describe accurately the relationships among meaningful attitude dimensions, even though it may be aesthetically pleasing to discover that this is the case. In any event, however, one must find other means of accounting for such relationships in psychological terms.

One effort in this direction has been made by Brim (20), who proposes to explain the U-shaped curve relating content and intensity on the basis of probability estimates. Brim presents data indicating that the relationship between estimates of the probability of occurrence of events and the stated certainty of these estimates is U-shaped. He suggests that the content of an attitude is based on the estimated probability of satisfaction to the individual and that estimates of 50 per cent probability may generally be equated with ignorance, indifference, and minimum intensity. With greater estimated probability of satisfaction or dissatisfaction, intensity, like certainty, increases. Brim suggests further that individual differences in both intensity and extremity of response to attitude and expectancy questions reflect individual differences in need for security. Data supporting this latter hypothesis are promised for the future.

Several contributions to latent structure analysis have been reported. Lazarsfeld (81) presents a conceptual introduction to the subject which supplements his mathematical formulation in *Measurement and Prediction* (80) by relating the elements of the basic equations to important concepts underlying social science procedure, e.g., probability and disposition. Gibson (46) offers an extension of Anderson's solution for the latent structure equations (5) which makes greater use of the empirical data. Hays & Borgatta (61) report that in 15 cases of nonperfect Guttman scales the general model of latent distance analysis provided a better fit than did the restricted model. They conclude that while the restricted model may be useful at an early stage of scale development, the general model is preferable for the final product.

In a study bearing on the Thurstone attitude scaling technique, Prothro (104) found that anti-Jewish Arabs acting as item judges rated items pertaining to Jews no nearer the favorable end of the scale than they rated the same items with no group specified. Prothro contrasts these results with those of Hovland & Sherif (68), who had found that strongly pro-Negro

judges displaced ratings of statements about Negroes toward the unfavorable end of the scale. One explanation of the difference which Prothro considers briefly is that in effect identification with a minority group may involve a kind of hypersensitivity affecting item placement, whereas prejudice against the group does not have a corresponding effect. This hypothesis deserves further investigation.

#### CORRELATES OF ATTITUDES AND OPINIONS

Virtually all of the year's studies of specific attitudes exhibit a conservative fidelity to the topics of ethnocentrism and voting behavior. In most cases these studies point at least implicitly to group membership variables as attitude determinants, but inquiries oriented primarily to such group processes are summarized in later sections.

*Ethnocentrism and prejudice.*—Undoubtedly the outstanding recent event in this area of social psychology is the publication of Allport's *The Nature of Prejudice* (3), a comprehensive and highly literate synthesis of the extensive research and theorizing of recent years. Among recent original research studies may be noted first a number which inquire concerning stereotypes and their role in prejudice. Prothro (103) reports that the data from a number of studies reveal important common features in the stereotypes which various national groups hold with respect to other prominent nationalities. Study of the stereotypes held by a sample of Armenian students suggested that features unique to subjects of a given nationality reflect unique experiences with the national group under consideration. Related conclusions were reached by Prothro & Melikian (105), who found that increased familiarity with Americans resulted in changes in the stereotypes which Arabs held about Americans.

Saenger & Flowerman (116) reported evidence suggesting that contact may reduce stereotypes but that a concomitant reduction in hostility does not necessarily occur. Other indications that stereotypes are not basic to prejudice are presented, e.g., that stereotypes of a disliked group resembled those of an accepted group. The authors state some provocative conclusions about the nature of prejudice. It is to be regretted that their causal interpretations rely so heavily on simultaneous questionnaire data and so little on tests of significance.

In several studies attention is devoted to the status correlates of white-Negro attitudes. Winder (155) compared the attitudes of lower- and middle-class white housewives in three Chicago areas varying in the degree to which Negro immigration had taken place. He found that acceptance of contact with Negroes decreased as the Negro population increased and that lower-class women were less accepting than middle-class women, who frequently exhibited a real conflict between prejudiced attitudes and equalitarian ideals. Winder accounts for his results on the basis of competition for housing, which was especially intense at lower-status levels.

On the other side of the fence Westie & Howard (148) studied the atti-

tudes of upper- and lower-status Negroes in Indianapolis toward contacts with whites of varying occupational statuses. The principal findings were as follows: upper-status Negroes expressed less distance toward whites in general; Negroes in general expressed least distance toward upper-status whites; lower-status Negroes tended to respond more categorically toward whites in general; Negroes in general responded most categorically to whites in respect to physical and interpersonal contacts as opposed to residential and official ones. The indications of symmetry in these two sets of results provide interesting support for the contention of Westie & Howard that intergroup attitudes need to be studied bilaterally.

Studies of the personality correlates of ethnocentrism and prejudice continue in general to follow and extend the trail blazed by *The Authoritarian Personality* (2). Using questionnaire items of his own devising, Stagner (132) obtained results with college students which were generally in agreement with those of Adorno *et al.*, e.g., persons accepting authority expressed intolerance of minority groups. Evidence for yet another variety of rigidity in the ethnocentric person was adduced by Steiner (133), who found that subjects high on the California Ethnocentrism (E) Scale were more likely than low ethnocentrics to state that traits close together on an evaluative scale occur together in individuals.

A new note in this area was struck by Perlmutter (101), who proposed that in some essential personality dispositions ethnocentrism might resemble its opposite, xenophilia (love of foreigners), since both involve a rigid distinction between in-group and out-group with respect to ideas about and attitudes toward them. Perlmutter constructed a xenophile scale and found that scores on this did in fact correlate with scores on the F-scale. Using the same sample, Brodbeck & Perlmutter (21) found that both xenophiles and authoritarians (high F-scale scorers) scored higher on a scale of self-dislike than did persons low on xenophilia and authoritarianism, these differences being more marked for men than for women. The authors attribute the differences in self-attitudes to conflict with parents during childhood. Unfortunately, as with many studies in this area, all items on all scales contain the same response set, i.e., "agree" answers are scored positively, and there is no way of telling to what extent the obtained correlations reflect this spurious common factor.

The possibility of changing ethnocentric attitudes and related personality factors has attracted several investigators. Pearl (100) reports that where individual psychotherapy failed to reduce ethnocentrism (as measured by the California E-Scale) in neurotic patients, group psychotherapy, either "intensive" or "brief" in character, succeeded. None of these procedures effected significant changes in F-scale scores, however, a circumstance which led Pearl to doubt the permanence of the E-scale changes.

Levinson (85) describes the program and results of a six-week summer Workshop on Intergroup Relations conducted at Harvard University in 1951. Several attitude scales, including "E" and "F," were administered

to this group and to controls before and after the workshop. Significant changes in scores were obtained for the workshop group as a whole, with individuals initially in the middle third of the group showing the greatest changes and those in the highest third the least. It is indeed difficult to assess studies such as these. Questionnaire criteria of change are sadly vulnerable to spurious influences, e.g., development of the notion that it is improper to admit prejudice in this situation. Assuming that such influences are as improbable as authors claim, then it is indeed worthwhile to know that valid changes can be brought about; but the large question remains as to just what factors are responsible.

*Determinants of voting.*—The past year has witnessed publication of two important social psychological analyses of voting in American presidential elections: *Voting* by Berelson, Lazarsfeld & McPhee (14), and *The Voter Decides* by Campbell, Gurin & Miller (23). The former volume reports a study carried out in Elmira, New York, during the 1948 presidential campaign, involving interviews with a panel of about 1,000 persons on four occasions between early June and late November. Voting intentions and reported votes were analyzed with reference to factors of social and political importance in the community, including formal organizations, social strata, informal groups, voter perceptions, transmission of information through discussion and mass media, and events occurring in the course of the campaign. The study was conceived along the same general lines as the 1940 study of Erie County, Ohio (82) but with the greater knowledge and sophistication made possible by that study and by subsequent developments. The results are seen by the authors as documenting more fully many of the general ideas developed in the earlier study, most notably the idea that voting decisions are influenced primarily by personal contact, and hence that the social structure of the community has critical importance by virtue of the personal contacts which it encourages and the pressures which these involve. At the same time more attention is paid than in the earlier study to the issues and to the activities of the political organizations with reference to these.

The approach taken by Campbell *et al.* (23) in their analysis of voting in the 1952 election is rather different. This study utilized a national sample of about 2,000 people, interviewed once just before the election and again just afterward. In their efforts to account for voting decisions the authors largely ignored demographic and group membership variables, on the explicit grounds that the relevance of particular categories of this sort varies from one time to another. Instead attention was focused on three factors conceived as intervening variables of a motivational sort: political party identification, orientation to national issues, and personal attraction to one or the other candidate. The analysis of the data related rough measures of each of these separately, and of the congruence between them, to the act of voting (as against not voting), to the choice of candidate, and to changes in preference from first to second interview. Each of the factors considered proved important, and conflict between them was shown, much as in the case of

Lazarsfeld's "cross-pressures," to conduce to nonvoting, changes in vote intention, and ballot-splitting.

Although there are some specific points of difference between the two volumes, it is difficult to see them as competing in any important respects. Rather the two approaches appear to be supplementary. If they can be combined, using more sensitive and better rationalized measures of social structure and individual motivation, even more rapid progress toward an adequate social psychology of voting should result.

Several articles appearing during the year confirm or supplement particular findings of the broad investigations just described. Hastings (60) found that nonvoters in Pittsfield, Massachusetts, were generally less involved in community groups and less interested in various aspects of politics than were voters. In a study carried out in Cambridge, Massachusetts, just after the 1952 elections, Maccoby, Matthews & Morton (88) found that the political preferences of people aged 21 to 24 (those old enough to have just voted for the first time) resembled those of their families most, their friends next, and their co-workers least. Factors conducive to deviation from parental views included strict discipline in the home (in the case of lower-status families), upward mobility on the part of the young person, and extensive formal education. These factors may also help to account for results obtained by Lenski (84), who studied "status crystallization," i.e., extent of agreement in the status of an individual with respect to income, occupation, education, and ethnic characteristics, as it related to attitudes and reported voting behavior in a representative sample of Detroit residents. He found low crystallization associated with more "liberal" tendencies.

In a discussion of "bandwagon" and "underdog" effects, Simon (129) shows that it is possible in principle to make a public prediction which will be confirmed even if there is a reaction to the prediction. To accomplish this in practice requires that the pollster know both the state of public opinion and the size and direction of tendencies to react to a published prediction. Simon does not attempt to say how the latter information should be obtained, but he does reassure the pollster that errors will affect election outcomes only under certain conditions.

The report by Berelson *et al.* (14) points out that data obtained by the panel technique lend themselves to analyses similar to the "process analysis" of modern economics. Some probability models for use in this connection are described by Anderson (4). As applied to panel data, these involve basically the computation of a series of matrices, each showing what proportion of the individuals expressing a given intention in one interview expresses each of the various possible intentions in the next interview. It is then possible, for example, to test the hypothesis that the matrix of transition probabilities is constant for any given sequence of interviews. Using data from the Erie County study of the 1940 election, Anderson showed that the transition probabilities were constant except over the period during which the political conventions were held. It also appeared to be possible to predict



the election outcome more accurately using a constant set of transition probabilities than by other means. These and the somewhat more complex models discussed by Anderson seem to hold great promise for the more precise description and analysis of changes in attitudes and behavior generally.

#### NORMATIVE PROCESSES

Groups and, for that matter, societies are identified primarily in terms of the uniformities of attitude and behavior which they exhibit and enforce within themselves and which set them off from at least some other groups. It may therefore be fitting that study of the normative processes which underlie such uniformities should continue to progress as rapidly as any area in social psychology.

*Pressures to uniformity.*—One of the liveliest research efforts of recent years started from Festinger's theoretical analysis of informal pressures to communicate (36). During the past year several studies have sought to re-interpret this formulation or to confirm or extend the research findings to which it has led. Simon & Guetzkow (130) have reworked those of Festinger's hypotheses pertaining to aggregative variables, i.e., variables measured by group averages, in an effort to achieve a more rigorous system. In the process they have introduced explicit postulates concerning linkages between variables, and also postulates which make possible consideration of certain changes and feedback effects over time. In the light of their reformulation the authors examine some of the empirical studies supporting the theory and find certain new deductions verified and some old interpretations in need of revision. For example, a finding of no correlation between cohesiveness and opinion discrepancy in the various buildings of a housing project was interpreted by Festinger, Schachter & Back (39) as consistent with the assumption that feedback had not yet taken place; according to Simon & Guetzkow the zero correlation "actually confirms the existence of feedback."

Schachter's experiment on communication to and rejection of deviates (117) provided a jumping off point for several experiments. It was replicated by Emerson (35) with essentially confirmatory results, except for a generally lower level of rejection of the deviate. Emerson ascribes this difference to his use of high school rather than college students; he assumes that for the high school boys the issue under discussion was less important and less a matter of already structured opinions. An experiment by Goldberg (48) confirmed Schachter's finding that the greater the initial distance of an opinion from the norm, the more it changes toward the norm. Schachter attributed this finding to the exertion of greater pressure by the group. Goldberg questions the applicability of this interpretation to his data since the norm in his experiment was fictitious and was simply announced by the experimenter to each subject individually. Consideration of the obvious fact of learning to respond to cues symbolic of group pressures might help to resolve this problem. Manipulation of such cues is, of course, one of the im-



portant devices of mass persuasion, and for that matter immediate group pressures are themselves in good part subtly symbolic of other and presumably more dire occurrences. Steiner (134) presents evidence consistent with the very reasonable view that "perceived" pressures to conform to "perceived" norms are important attitude determinants, even though actual norms are nonexistent.

An important extension of the Schachter experiment is reported by Schachter and seven European psychologists (119). This first study of the Organization for Comparative Social Research was instituted primarily to explore some of the problems of cross-cultural research on social psychological variables, but it has relevance in the present context because of the particular problem selected for replicated study in the seven European countries. This problem concerned the relationship between goal valence and probability of goal achievement on the one hand and tendencies to change others and to reject deviates on the other. The groups were "clubs" of six or seven boys who were attempting to reach agreement on which of several model planes they would build for an inter-club competition, with a stooge holding out for an undesirable one. A check revealed that the experimental manipulations were not adequately effective in three of the countries—England, Germany, and Belgium. In the remaining four countries, Holland, Sweden, France, and Norway, the principal result was that under all conditions the deviate was rejected. Except in the Norwegian experiment, extent of rejection was unaffected by valence of the goal, but it increased with decreasing probability of goal attainment. In a discussion of the ambiguities of the results, it is suggested that these can be resolved in terms of a theory which employs the concepts of cohesiveness, tendency to redefine the group, and tendency to integrate, and which posits a U-shaped relation between probability and rejection.

In what seems to be a minority report on this point, de Monchaux & Shimmin (32) of the English research staff point out the possible role of certain cultural factors in explaining the extreme deviation of the English results and question the suitability of experimental procedures for dealing with group phenomena in general and with variables of the present order of complexity in particular. Evidently this is a case in which the deviate does the rejecting.

The conditions under which individuals acquire the capacity to influence others have been investigated in a number of studies. Mausner (90) found that stooges on whom success had been conferred in previous trials influenced subjects' judgments of the length of lines significantly more than did previously failing stooges. Generally similar findings were obtained by Schein (120) under the aegis of Miller & Dollard's theory of imitation. Subjects learned to imitate a model who was consistently called correct, and this generalized to a new but similar situation where knowledge of results was no longer provided. However, rather considerable individual differences were observed, and these were interpreted as "reflecting a complicated com-

promise between the various motives that were operating in the experimental situation and the degree to which the model's behavior was understood by Ss."

Effects of military status and previous association on ability to influence group problem solutions were studied by Torrance (143) in established B-26 crews and in essentially similar groups temporarily assembled from B-26 personnel. The B-26 crew is made up of three men: pilot (commanding the aircraft), navigator, and enlisted gunner. Influence, measured in terms of correspondence between individual and group solution, proved to be a direct function of this hierarchy of military status, but this was less definitely the case in temporary crews.

A further variable in ability to influence is highlighted in an experiment by Thrasher (142), who found that as a stimulus field was rendered progressively less well structured, a subject's perceptual judgments were influenced increasingly by those of a friend, and disproportionately more than by those of neutral individuals.

Several papers by Blake and his students describe some ingenious techniques for the controlled study of group pressures both in the laboratory and *in situ*. Olmstead & Blake (96) showed that in judging number of metronome clicks, subjects were as much influenced by listening to tape-recorded judgments by persons represented as being other group members in other rooms as they were by face-to-face groups, and that behavior in both situations differed appreciably from behavior alone. Rosenbaum & Blake (114) demonstrated that when students were approached in a college library and asked to serve as subjects in an experiment, their response was determined to a very great extent by the prior response of a nearby stooge to the same question. In similar vein Blake, Rosenbaum & Duryea (17) showed that students asked to contribute to a gift for a departing secretary were significantly influenced by a peek at a list of figures purporting to represent donations by other people. In this case the mean value of the list had an effect, but the variance did not.

*Resistance to social pressure.*—The recent literature of group behavior seems to evidence an encouraging tendency to regard at least some cases of nonconformity as psychologically healthy and even socially desirable. Kelley & Shapiro (74) inquired whether, if a norm is out of touch with reality and hence detrimental to the group, better accepted members will conform less than members not so well accepted. Experimental comparison of subjects exposed to procedures designed to induce different feelings of acceptance failed to support the hypothesis. However, actual acceptability, as judged by others, was found to be related to nonconformity among persons who placed high value on their membership.

Hochbaum (64) reports that in an experimental situation similar to that of Schachter (117) little change in response to group pressures was shown by deviant subjects who had a high degree of confidence in their ability to deal successfully with the issue at hand. Both degree of deviation and confidence in ability were manipulated experimentally.

In a similar three-man group situation Mills (91) studied certain personality correlates of changes exhibited by subjects during the course of a discussion. At the outset the subject was warmly supported by a stooge in argument with a third person (also a stooge), but gradually this supporter switched to the other side. As a result subjects showed some behavioral changes in the direction of the role of lone opponent. Individual differences in degree of change in the ratio of positive to negative behavior, as well as differences in degree of change in opinion on the issue, were examined in relation to socio-economic status and three need scores obtained from a short Thematic Apperception Test. These were achievement, dependency, and self-enhancement, the last being a combination of elements of the other two. The clearest findings were that high-status subjects low in need for self-enhancement were most ready to give up the isolate role, and, less definitely, that high-status subjects high in need for self-enhancement were most disposed to maintain this role. It appears that in the general context of Mills' experiment, and with reference to an issue possibly not seen as particularly important, the presumably secure individual may comply as a matter of course, whereas the presumably less secure individual may feel constrained to oppose.

Janis & Feshbach (72) reported further results supporting their hypothesis that communications arousing a high degree of anxiety in the recipient tend to stimulate defensive reactions which interfere with acceptance of the communicator's message. Using data from an earlier study (71) in which they showed that strong fear appeal produced less attitude change toward acceptance of the communicator's message than did a mild fear appeal, the authors examined the effects of individual anxiety level, as measured by response to an inventory of hypochondriacal and anxiety symptoms and by teachers' ratings. They found high-anxiety subjects less influenced than low-anxiety subjects by a strong fear appeal and more influenced by a mild appeal. Some question is raised about the Janis-Feshbach hypothesis by the failure of Moltz & Thistlethwaite (92) to produce differences in manifest anxiety using the experimental variations of the initial study. One wonders, however, whether a denial of manifest anxiety may not be one of the defenses Janis & Feshbach are talking about.

Resistance to a given set of normative pressures may reflect not only the personality of the individual and his perception of the requirements of the present situation, but also his adherence to the standards of some other group. Several sociological studies describe interesting examples of role conflicts of this sort. Rosen (113) discusses the dilemma of young Jewish students with respect to kosher food practices and presents evidence for the general prepotency of peer groups over family groups in determining the individual's decision. Getzels & Guba (45) delineate the conflicts of Air University instructors with respect to officer and instructor roles, and Burchard (22) treats of the somewhat similar conflicts of the military chaplain. The important questions here concern the conditions which determine that one membership or reference group will win out over the other, or that

some kind of compromise will be reached. Some pertinent evidence is reported by Gerard (43), who found that when members of groups which had discussed an issue were later challenged on the issue by an ostensible outsider, those who were from groups which were more attractive to their members, and who agreed with others in the group, showed less opinion change and more effort to convert the outsider. Evidence essentially to the same effect is provided by Andrews, Smith & Kahn (6), who report that Chinese and North Korean troops were more readily influenced by psychological warfare appeals to defect and surrender if they were unsympathetic to the war aims of their own side or showed other indications of poor morale. In other words, conditions making for stronger norms initially will make possible greater resistance to competing influences. However, there are undoubtedly further temporal and situational factors that need to be examined. The possibility that conflicts in experimentally developed norms can be studied systematically over extended time periods is suggested by the finding of Rohrer *et al.* (112) that norms of perception of the auto-kinetic phenomenon developed in a group situation may persist on individual retest one year later.

A relatively simple model taking account of various of the above factors in resistance to social influence has been advanced by Osgood & Tannenbaum (98). This involves reference to original attitude toward the source of a message, original attitude toward the object evaluated by the message, and the nature of the evaluative assertion. Degree and direction of attitude changes are assumed to be functions of the congruity of these three items, degree of polarization of the attitudes, and degree of incredulity regarding incongruous messages. Data from a recent experiment were shown on the whole to support the theory.

*Social comparison processes.*—While the work inspired by his analysis of pressures to conformity continues, Festinger himself has extended his theoretical ideas to take account of social comparisons with respect to abilities as well as opinions (37). According to this formulation social influence processes and some kinds of competitive behavior are manifestations of the same social-psychological factors. Both are assumed to stem from a drive for self-evaluation and from the common necessity that such evaluation be based on comparison with other persons. For example, it is assumed that people seek out groups similar in relevant abilities as well as opinions. Where discrepancies in ability develop, members of the group tend, just as in the case of opinions, to change the status of others, to restrict the range of comparison, or to change their own status, the choice of these being dependent in part on their own position relative to the rest of the group. The principal differences between processes affecting opinions and abilities are assumed to arise from the circumstances that people are biased toward improving their abilities (there is a "unidirectional push upward"), and that this is not always easy to do.

Several researches are reported which test various aspects of this formu-

lation. An experiment by Hoffman, Festinger & Lawrence (65) made use of a game in which three players compete for points, but in which no one can gain points without forming a coalition with another player. If A forms a stable coalition with B when C has an initial advantage, it may be assumed that A and B are competing with C in an effort to reduce his advantage. According to the theory they will be more likely to do this when the task is seen as being important and when C is seen as being not too different from themselves in ability. Manipulations of these two variables yielded results favorable to the theory.

An experiment by Festinger, Torrey & Willerman (40) tested the proposition that increasing the attraction of a group for its members will increase feelings of inadequacy on the part of members performing less well than others, as well as feelings of adequacy on the part of those scoring as well as or better than others in the group. Attraction was varied in the usual manner by informing the subjects that they had been assigned to congenial or uncongenial groups. Three persons in each group were consistently given scores very close together on a series of tests, while the fourth always scored lower. Self-estimates of adequacy of performance were found to conform to theoretical expectations. Evidence consistent with this same proposition was obtained in a correlational study of teacher attitudes by Rasmussen & Zander (106), who found that when a teacher did not measure up to the professional standards of a faculty subgroup, his feelings of professional inadequacy were greatest if this group was very important to him. The relevance of the performance to the group was also a factor.

Dreyer (33) studied level of aspiration as a function of preperformance expectation of success and failure, and of reported performance level, both variables being manipulated experimentally. Evidence that subjects in the medium performance groups were the only ones competing against the fictional group average was seen in the finding that only in these groups did the preperformance expectation of success result in higher levels of aspiration with experience. Furthermore individual variability in aspiration was smaller in these groups, and feelings of success and failure were more pronounced. A further prediction of Festinger's theory was partially confirmed in that high-performance groups stopped sooner than low-performance groups, although medium-performance groups did not stop sooner than low-performance groups. Pressure toward comparability of abilities was accordingly considered to be complicated by a drive for improvement.

#### PERSONAL RELATIONSHIPS

Although the literature is by no means devoid of purely descriptive accounts of personal relationships in particular groups, there is still evident the encouraging trend of recent years toward more systematic analyses of interpersonal relations and of the factors responsible for the development of various patterns of relationship.

*Factors related to informal association.*—Several studies of interpersonal

perception are worth noting here. Using an approach somewhat similar to that of Fiedler, Warrington & Blaisdell (41), Davitz (30) showed that children in a summer camp perceived themselves as more like their highest sociometric choices in preference for camp activities than was actually the case, and as more like their highest than their lowest choice, despite the lack of any difference in actual degree of similarity in the two cases. The author regards these findings as evidence of a need to be similar to valued persons. Essentially similar results are reported by Jahoda (70), who had British subjects rate photographs of obscure Members of Parliament on "Looks" and "Intelligence," and also attempt to identify the party membership of the pictured politicians. The subjects agreed fairly well in their ratings but tended to identify favorable ratings with membership in their own political party, whatever that might be. Sherif, White & Harvey (128) found in experimentally formed groups of boys at a camp that, regardless of actual skill in throwing balls at a target, the performance of high-status boys was overestimated by other boys and that of low-status boys underestimated. The relation between status and rated performance was higher in the more stable group. The foregoing studies may have relevance for Festinger's theory of comparison processes discussed in an earlier section.

Relationships between sociometric choices and sociometric status were analyzed also by Riley *et al.* (107), who found that high school girls reported liking girls of higher status best and those of lower status least, while confidence that liking was reciprocated showed the opposite trend. Since certain results seemed to support the authors' initial hypothesis that actual relationships are symmetrical and largely within status categories, the authors assume that it is only the tendency to name the other girl which increases with her status relative to the subject. They then show how columns of the obtained sociometric matrix can be multiplied by an appropriate constant to yield values in agreement with their initial assumptions, and reach the methodological conclusion that such a procedure may be useful more generally in extracting valid descriptions of reality from questionnaires.

In a study of an isolated air defense site, Gross (50) analyzed attitude dimensions related to membership in informal groups, i.e., those centering about such activities as eating, holding "bull sessions," and spending time off base. Highly cohesive groups were generally satisfied with the Air Force and its goals, but not with their jobs and the site. Isolates, on the other hand, tended to like their jobs and the site, but not the Air Force. Gross sees membership in the small group as satisfying personal needs not otherwise met in the situation.

In a number of studies experimental procedures have been employed to identify circumstances affecting development of personal relationships. A nicely designed little experiment by Rosenberg & Curtiss (115) showed how interacting with a stutterer serves to depress speech and bodily movements on the part of normal subjects.

In a somewhat more complicated experiment carried out by Festinger &



Hutte (38), the behavior of subjects in six-person groups who were told that their two best-liked fellow members disliked each other was compared with the behavior of subjects told that their two best-liked fellows liked each other. The former subjects showed less stability in subsequent choice-behavior and greater sensitivity in guessing how others rated them. Essentially similar results were obtained in parallel experiments in Holland and in this country.

Shaw & Gilchrist (126) found that in a series of tasks performed simultaneously by two-person groups, failing persons initially chose as partners for the next task individuals who were successful. But if these choices were repeatedly not granted the subjects adjusted to reality and chose the persons whom they had chosen successfully before, even though they had consistently failed the task together. A simulated fight between the chronically successful stooges strengthened this tendency to choose again the previous partner in failure, a result which is attributed to the over-riding of other considerations by avoidance tendencies instigated by the expression of hostility.

Some of the findings just described could well be integrated in terms of a rudimentary theoretical model developed by Roby & Rosenberg (111) for the study of reactions to brief interpersonal contacts. The authors analyze the factors affecting the output of cues by a "stimulus-subject," the transmission of these to a "response-subject," and the reactions of the "response-subject" to the cues he receives. Attention is then given to considerations bearing on the validity of these reactions for predicting subsequent behavior of these or similar subjects. This effort to dispel some of the mysteries of interpersonal relations with the aid of general notions deriving from behavior theory arises, as did sociometry, from a practical concern with the formation of effective groups. It is one of a series of reports dealing with the problem of assembling individual Air Force specialists into bomber crews.

Roby's first paper in this series (108) discussed this general problem systematically with reference to three major aspects: (a) the definition of predictor measures on the constituent individuals, (b) determination of functions of such individual scores which best predict group performance, and (c) determination of simultaneous combinations of groups, or "assemblies," which best satisfy a given practical requirement. Each of these problems turns out on analysis to be extremely complicated, and various research approaches are suggested which might aid in achieving some simplification.

Two subsequent reports by Roby consider the use of scores obtained on pairs of individuals in assembling individuals into compatible groups. The first of these (109) demonstrates that if they are to be maximally useful, such scores must satisfy certain statistical prerequisites, namely, in the case of choice scores, low agreement among raters in general, high mutuality of choice, and high agreement between mutual choices in ratings of others. The second paper (110) presents evidence that the first two requirements were satisfied in choices of crew mates made by prospective B-29 crew members after limited contact and suggests ways in which still more satisfactory



preference data might be secured. Although these reports do much to systematize a previously little explored problem area, it should be noted that conclusive evidence remains to be obtained that self-selection or other assembly procedures are worthwhile for work groups such as bomber crews.

Such evidence would probably be considered unnecessary in our culture in the case of marital partners, but there are many unanswered questions as to just what combinations of individuals do achieve effective marriages. Winch (152) has advanced the general hypothesis that within the "field of eligibles" defined by homogamy of social characteristics, the individual tends to select a partner having motivations complementary to his own, e.g., an ascendant man seeks a submissive woman and vice versa. Two papers with Winch (153, 154) as an author report results of a test of his hypothesis on a small sample of married students and their spouses. Motivational variables derived in large part from Murray were appraised on the basis of interviews and Thematic Apperception Test responses. Interspousal correlations on selected pairs of variables were preponderantly in the direction demanded by the theory and significantly different from those for randomly assembled couples. If it can be assumed that the motivational status of the individuals had not changed in favor of the theory since the time of initial meeting, this study provides impressive evidence for the theory.

*Methodology for study of personal relationships.*—Note should be taken of a number of articles concerned with methodology. Mouton, Blake & Fruchter (94) summarize studies bearing on the reliability of sociometric measures. The same authors found in an experimental study (16) considerable agreement among observers, fellow participants, and the individuals themselves in rating certain aspects of individual behavior in a group discussion. Agreement was best for "contribution to group decision," "clerical work," "leadership," and "dominance," and least for attitudinal variables such as "satisfied with group decision," and "frustrated." Generally similar consistencies were observed between a first and a second session, despite changes in observers, group composition, and discussion topic.

Tagiuri, Bruner & Kogan (135) describe a mathematical model for estimating the chance frequency and variance of various diadic relationships obtainable through "relational analysis." The choice expectancies are based on assumptions of robot-like behavior rather than Monte Carlo methods or the binomial expansion. The assumptions involved and possible applications of the model are discussed. Willerman (149) describes an application of Kendall's coefficient of concordance to sociometric matrices where, typically, the diagonal is missing. A similar procedure is outlined independently by Taylor (138, 139) in the course of an extended discussion of the analysis of emotional relationships in small groups. Taylor considers "love-hate feelings" and "guessed self-appeals" with reference to three dimensions presumed to be important in groups—public, diadic, and autistic. Statistical methods for estimating variables in each dimension from self-report data are suggested

and illustrated using data obtained from a series of therapy groups. Harary & Ross (57) elaborate a formula for determining the number of complete cycles in a communication network or sociogram, a complete cycle being a path through which an item of information initiated by one group member will return to him after having passed through each of the other members just once. Thrall & Angell (141) propose a method for measuring the "height" and "spread" of groups within the status structure of a community by utilizing common memberships of individuals in community organizations.

#### LEADERSHIP

Certain of the studies discussed under the head of "Normative Processes" identify conditions favoring assumption of an influential role by a group member. Other factors of relevance to leadership emerge from the studies summarized below.

*Effective leadership behavior.*—The finding of Chowdhry & Newcomb (28) that group leaders estimate group opinion on relevant issues better than do nonleaders continues to have an impact on students of leadership behavior. Greer, Galanter & Nordlie (49) found that leaders of nine-man Army rifle squads estimated more accurately the preference of squad members for other members than did nonleaders. Likewise the more popular members estimated more accurately than did less popular members, and, finally, average accuracy was greater in more effective than in less effective squads, effectiveness being measured in a well controlled field test situation. Since leaders of effective squads were more intelligent, there seems to be a real question whether accuracy of group estimates has any causal significance in this last connection.

Talland (136) hypothesized that the Chowdhry-Newcomb effect is attributable to determination of group opinion in large part by the leader. He found in seven therapy groups that leaders, determined by member rankings with respect to leadership role, dominance, and popularity, did no better than other members in estimating the average ranking by individual group members of the therapeutic value of various discussion topics. However, after a group discussion aimed to achieve a collective ranking, it was found in six of the seven groups that the initial ranking by the leader was closer to the final collective ranking than was that of any other group member. Talland sees this finding as confirming his hypothesis, but such a conclusion is not compelling. For example, it is not certain that the leader did determine the collective ranking; he may simply have forecast it. It seems more likely that the discussion in this case provided the first real opportunity to assess group opinion and that the leader was more highly motivated not only to influence opinion but to determine what the actual consensus was. One would guess, however, that even if his views did not prevail, he would probably manage to be pretty clear about the conclusion actually reached. In a somewhat related industrial study, Johnson (73) found that while supervisors

predicted responses of subordinates equally well regardless of the latter's morale, subordinates with good morale predicted supervisors' responses better than did lower morale subordinates.

Some further studies of leader perceptions are reported by Fiedler (42), although the term "leader" is not used. In both basketball teams and surveying teams, Fielder found that the more effective the team, the more the team member most preferred by other members as a co-worker tended to see his own most preferred co-worker as being different from his least preferred co-worker. In other words, in effective teams the most influential individual tended to be most discriminating in his judgments of fellow members.

Altogether it seems that the studies of leader perceptions raise questions which can be answered only if attention is paid more directly to leadership behavior and the processes of leader-follower interaction. Some of the studies during the past year describe or analyze leadership roles developed "naturally" in established groups. Hollander & Webb (67) intercorrelated total nominations received by naval air cadets for positions of leader, follower, and friend. Leadership and followership correlated highly ( $r = .92$ ), but correlations of friendship status with the other two variables were only moderate. This presumably implies that leader and follower roles have something in common, but it does not tell us what this is.

Blau (18) describes a government agency headed by an overly evaluative supervisor in which unofficially agents relied heavily on advice and criticism by colleagues. As a result the more competent agents enjoyed a position of informal leadership, as measured by contacts made with them by others, esteem expressed by others, and behavior in conferences.

In an exploratory study of role distribution in B-29 crews, Haythorn (63) used scales and single items from a "guess-who" questionnaire asking each crew member to indicate who in the crew typically performed various informal activities of a sort frequently associated with a leadership position. A small sample of crews was split into a high or low category on each of two variables, rating of performance on training missions, and degree of liking among crew members. Differences among these four criterion groups in distribution of each role among the 11 crew positions were tested by analysis of variance. Within the high-performance category the largest profile difference was found between the high-liking crews and the low-liking crews on a scale of "nurturant" behavior. Aircraft commanders in the former stood high relative to other positions and to other aircraft commanders, while the aircraft commanders in the latter group stood very low in these respects.

From this and previous efforts to deal empirically with the concept of role, it is evident that this approach offers promise, but that much remains to be done by way of conceptual clarification and development of appropriate measures. Certain problems of measurement are discussed by Davis, Hagedorn & Larson (29) in reporting the development of Guttman scales to

measure leadership roles of Air Force officers, and Wilson *et al.* report the application of a factor analytic (150) and of the Wherry-Gaylord iterative technique (151) to scaling of statements describing supervisory and group behavior.

Several experimental studies bear on the role of leadership in group development. Singer & Goldman (131) compared "authoritarian" and "democratic" procedures in a series of therapy sessions with two groups of schizophrenics. They found that the group handled in an authoritarian manner initially made more relevant comments than did the democratically administered group, but this difference was gradually reversed with successive meetings, while at the same time the democratic group began to evidence higher morale. The authors infer that it may be best to start with an authoritarian structure and gradually shift to a democratic one, but, of course, they have in this experiment neither the degrees of freedom nor the experimental arrangements needed to confirm this plausible hypothesis.

Levy (86) assessed the effects of a series of experimental conferences upon the attitudes of 11-man B-29 crews undergoing training in a program which allowed little time for informal crew interaction. Each of one set of crews had a series of conferences led by a psychologist experienced in group therapy, while in another set the crew conference was led by the aircraft commander. In each case the crew was free to discuss any subject it wished; generally problems confronting the crew were chosen. No differences were found between the psychologist-led crews and a control set, but the crews whose conferences were led by their commanders developed significantly more satisfaction with the Air Force, pride in their crew, and liking for crew mates. Levy attributes these changes to the opportunities for interpersonal orientation provided by the conferences and hypothesizes that the presence of an outsider, the psychologist, in the leadership position disrupts this orientation process.

Another source of influence on development of attitudes in B-29 crews was investigated by Lanzetta & Haythorn (79), who studied the relations between instructor crew attitudes toward human relations problems and changes in corresponding student crew attitudes during training. The authors hypothesized that within a student crew attitudes would tend during training to converge about the mean for the instructor crew, in a degree depending on the prestige of the instructor crew. Instead they found that attitudes within student crews diverged as training progressed, although at the same time instructor crew prestige declined on the average. In accordance with prediction, the variance of student crew attitude about the instructor crew mean correlated negatively at the end of training with instructor crew prestige. Cohesiveness of the student crew was not a factor.

An interesting finding with respect to leadership training is reported by Harris & Fleishman (59). In accordance with previous results, plant foremen who had just received a course in supervision were found not to show, back in the plant, any mean change in reported leadership behavior or in leader-

ship attitudes as a result of training, nor any mean difference from foremen not receiving such training. However, the trained group exhibited significantly more changes in individual status in these respects, as evidenced by significantly lower correlations between pre- and posttraining measures. Further study of this phenomenon is obviously called for to determine to what extent such changes are in the direction of more effective accommodation to the specific requirements of the individual foreman's situation.

*Leader personality.*—Recent investigations of the personality traits of leaders have tended to concentrate on leaders emerging in small, informal group situations. General evidence that personality is important for achievement of leadership in such groups is presented by Borgatta, Bales & Couch (19) in the report of a study oriented toward the "great man" conception of leadership. In each of four group sessions, every one of the 126 airman subjects participated with two others from this sample who had not previously met him or each other. In the first session, 11 "great men" were selected from the 42 groups on the basis of an index representing the product of four scores: two measures representing "task ability" (a leadership rating by co-participants, and an IQ); a measure of "individual assertiveness" (acts initiated per unit time during the group session), and "social acceptability" (sociometric popularity). In subsequent sessions the "great men" tended very noticeably to retain top positions, and in all sessions the groups in which they took part showed significant indications of smoother functioning.

Possible suggestions as to personality factors which are important come from a study by Cattell & Stice (26) who examined scores on Cattell's 16 Personality Factor Questionnaire obtained by leaders and nonleaders in 34 specially assembled 10-man problem-solving groups of new Air Force and naval recruits. This was done separately for four different criteria of leadership: (a) "problem-solving," i.e., most frequently checked by observers as influencing the group in various situations, (b) "salient," i.e., agreed upon by observers as most important leader in various situations, (c) "sociometric," i.e., recalled by group members as having been the most important leaders in the groups, and (d) "elected," i.e., actually elected as leader by group members. In all cases leaders excelled nonleaders in "character integration," "absence of worrying anxiousness," "adventurous cyclothymia," and "deliberate will control." On certain other factors the profiles differed from the different leadership criteria. In general the greatest resemblance existed between difference profiles for the "salient" and "sociometric" criteria and the least between "sociometric" and "elected." For the "elected" criterion a multiple correlation of .91 is reported between the criterion variable and various 16 P. F. factors. This relationship is presented "to illustrate" the use of a multiple regression equation; the coefficients for the other criteria are not given.

The authors' impression that this coefficient is the highest to be found in the literature is certainly congruent with the findings of Bass' review of leaderless group discussion studies (9). Between performance in leaderless

group discussion and status on specific personality measures almost no correlations higher than .30 have been found where sample size has been reasonably adequate. Correlations with measures of intellectual capacity or achievement have tended to be somewhat higher. Also congruent with these general results but of interest nonetheless is Hollander's finding (66) that naval aviation cadets nominated for leadership positions by fellow cadets tended to stand lower on the F-scale ( $r = -.23$ ), regardless of the status of the cadet making the choice.

#### GROUP PERFORMANCE

Group studies treated in preceding sections consider the factors accounting for group characteristics; in the present section the primary question is one of how such group characteristics relate to group productivity. Systematic studies of group productivity appear to be on the increase, as appropriate research procedures and facilities become available to the military, industrial, educational, and other institutions which have such a vital interest in this subject. Thelen (140) describes various instances of group action in relation to school, community, and industrial problems and presents a broad theoretical analysis of the processes involved.

*Individual and group performance.*—Not many years ago studies of group behavior were very much concerned with the relative superiority of groups and individuals in solving problems. Although this question no longer holds the center of the stage, it is still with us. Moore & Anderson (93) investigated differences between three-man groups and individuals in a trial run of a laboratory situation requiring application of the calculus of propositions to a series of complex symbolic problems. They found no mean differences in performance, but groups consistently showed less variance among themselves than did individuals.

Using problems similar to those of Shaw (121), Marquart (89) essentially replicated Shaw's experiment, with similar results. However, Marquart notes that Shaw's conclusions about group superiority hinge on comparing percentage of possible successes attained by individuals to percentage of possible successes attained by groups. A fairer comparison, she thinks, involves treating individual successes on a group basis, e.g., if when working individually, one of the three individuals who later make up a group gets the correct answer, individuals are credited with one success in one trial, rather than with one in three. On this basis individuals turned out both in Marquart's results and in Shaw's to be slightly superior.

The same point is made more systematically by Ekman (34) under the heading of the "probability effect." Ekman raises the question as to just what factors ("effects") may account for differences between individual and group productivity. In addition to the "probability effect," i.e., the increased probability of a solution as a result of increasing numbers, he identifies three: the "individual effect," i.e., social facilitation or inhibition; the "summation effect"; and the "average effect," i.e., the case in which the team's

performance is in some fashion an average or compromise of individual performances. Ekman describes in each case some experimental situations and results which have evidently been published more fully in Sweden. This reader does not see any conceptual difference between the summation and average effects. Obviously, too, these effects, and the individual effect, may involve quite a few distinct processes. However, Ekman's "effects" are interesting because they lend themselves to mathematical formulation in a way suggestive of possibilities for further model development.

This is exactly the kind of new wine which Hays & Bush (62) have, independently, attempted to pour into this old bottle. These writers start with a simple two-choice guessing situation of the sort used initially by Humphreys (69). Various studies have shown that individuals learn to guess one of the possibilities with about the same frequency as it is actually presented (although always guessing the more frequent would prove correct more often). Two extreme models are suggested by Hays & Bush which might apply to a group's performance in this situation: a voting model, which would assume independent guessing and majority rule, and a "group-action" model which would assume that after interaction the group acts like an individual. The former model leads to the prediction of slower group-learning with a higher asymptote. Data obtained from 100 trials with each of 21 three-man groups did not permit a conclusive choice between these models, but did provide the authors and their readers with food for thought about the complexities of even this situation, and about some of the additional requirements of models appropriate to describe it.

*Communications networks as factors in group performance.*—Shaw reports a series of studies of small laboratory groups along the lines initiated by Bavelas (10). In a first experiment (124) Shaw attempted to determine the effects of unequal initial distribution of problem-related information in groups of varying structure. He found that information distribution had no effect upon over-all group measures of performance effectiveness or of morale, but that increasing information initially available to an individual within a structure had effects similar to those of increasing the centrality of that individual, i.e., the individual having more information performed more rapidly, had higher job satisfaction, and received more sociometric choices. In this experiment the additional information was never given to a person already enjoying a centrality advantage. Hence in a further experiment with four-person "wheel" structures (in which three persons can communicate directly only with the one central person), Gilchrist, Shaw & Walker (47) examined three conditions of information distribution: equal, most information given to the central person, and most information given to a peripheral person. Again it appeared that there were no differences among the conditions as regards group performance, but some evidence is presented for a loss of efficiency by the central person when he is given most initial information, and it is suggested that this is attributable to "saturation" of his position with requirements for information processing.



Shaw's first experiment (124), noted above, found longer problem solution times in the "wheel" structure than in the "circle" (in which each person can communicate directly with the two persons adjacent to him) whereas Leavitt (83) had found opposite results. Shaw hypothesized that the difference resulted from his own use of more difficult problems, and in a further experiment tested this hypothesis with generally positive results (123). In addition this study produced evidence that a measure of "independence" of the individual position in the net correlates better with individual morale and performance measures than does a measure of "centrality." The independence measure, described in another paper (122), takes into account the number of communication channels available to the individual, the total number of channels in the net, and the number of individuals for whom a given individual serves as a relay of information.

A final report by Shaw (125) describes an experiment comparing "authoritarian" and "nonauthoritarian" leadership on the part of the most "independent" member in each of three different four-person structures. Authoritarian leadership was found to produce better performance and poorer morale regardless of the type of structure. This result is attributed to the tendency of authoritarian leadership (a) to reduce over-all saturation, which has the primary effect of improving performance, and at the same time (b) to reduce over-all independence, which serves primarily to lower morale.

*Motivation and group performance.*—It is well established that motivations and attitudes are importantly related to group performance, but the nature of these relationships and the circumstances which modify them in particular situations still need considerable clarification.

Knoell & Stice (76) describe the development of a series of attitude scales relevant to membership in B-29 crews. A set of such scales obtained midway in this development process is considered in a somewhat earlier report by DeGough & Knoell (31) with respect to relationships with combat performance. The latter study showed first that variance in mean crew scores on eight scales could be accounted for by three factors: (a) an aggressive, devil-may-care attitude toward Air Force life, (b) a general sense of job satisfaction, and (c) pride in one's own crew. Superior officers' ratings of concurrent combat performance by the crews showed no correlation with the first factor, a low correlation ( $r = .16$ ) with the second, and the highest ( $r = .36$ ) with the third.

These and previous results make it clear that in groups such as bomber crews interpersonal attitudes are in general related to group performance. At the same time, there are indications that this relationship is somewhat complex and subject to certain contingencies. A suggestion that the relationship may in some cases be curvilinear comes from a study by Adams (1), who found that up to a point the more equalitarian the attitudes expressed by officers on B-29 crews, the more effective was the crew in training; beyond this point crew performance tended to drop off. A reminder that normative

processes must also be considered is provided by Berkowitz (15), who confirmed the findings of Schachter *et al.* (118) that group cohesiveness (i.e., interpersonal liking) makes for high productivity when there are group pressures in this direction, but for low productivity when the norm is reversed. Berkowitz showed, in addition, that these effects persisted undiminished when group pressure was removed.

A further problem in connection with attitude-performance relationships concerns causality. Studies such as that of Berkowitz demonstrate that under appropriate conditions development of favorable attitudes causes better performance. However, a very tidy experiment by Payne & Hauty (99) warns against the too ready assumption that attitude differences have performance effects in all situations. In this experiment the effects of two levels of experimentally induced motivation and five drug conditions were evaluated in terms of individual attitude toward and performance on a long and complicated pursuit task. Both experimental variables affected attitude, but only the drug conditions affected performance. In the case of the bomber crew and similar work-groups, it appears likely that the relation between attitude and performance is circular, that while favorable interpersonal attitudes may conduce to effective co-operation, nevertheless highly favorable attitudes cannot develop without some experience of success, e.g., in flying together safely.

That experimentally induced success may produce more favorable attitudes toward the group and greater acceptance of group decisions was demonstrated by Shelley (127) in a study of group level of aspiration. Additional findings indicated that group level of aspiration phenomena are essentially similar to the corresponding phenomena in individuals.

*Co-operation, conflict, and stress.*—Guetzkow & Gyr (53) observed over 100 conference groups in business and government organizations to determine under what conditions conflict does or does not end in consensus. In the majority of cases conflict did not end in consensus, and this was as true for substantive as for affective conflicts. In both types of conflicts, achievement of consensus was associated with little expression of self-oriented needs, with the satisfaction of such self-oriented needs as were expressed during the discussion, with a generally pleasant atmosphere and recognition of a need for unified action, and with orderly problem-solving procedures. In addition, substantive conflicts ending in consensus involved an emphasis on factors contributing positively to this end, e.g., warm personal regard among participants, while affective conflicts ending in consensus exhibited the operation of restrictive factors, e.g., withdrawal of participants from interpersonal contact. Among the factors which did not contribute to consensus were the use of formal procedure and the urgency of reaching a decision.

In interaction analyses of 90-minute sessions of therapy groups, Talland (137) failed to find the sequence of orientation, evaluation, and control, together with the tendency to equilibrium in successive cycles, which Bales

(8) had previously reported for laboratory discussion groups. Talland accounts for his results on the grounds that it is the business of a therapy group to keep things stirred up, rather than to solve neat little discussion problems.

Effects of experimentally-contrived sets toward co-operative and competitive behavior were studied by Grossack (51). In the co-operative condition subjects were told that the group would be rated as a group and the best group rewarded, while subjects in the competitive condition were told they would be rated and rewarded individually. Co-operative subjects showed more cohesive behavior, including exertion and acceptance of influence, and received more instrumental and fewer antagonistic communications.

More difficult to evaluate is a study by Olmsted (97), who compared two series of four-man groups, one given initially some manufactured evidence favoring "process-orientation" in groups, the other given parallel evidence favoring "task-orientation." Interaction during the problem-solving discussion was analyzed using Bales' categories (7), and questionnaire data were obtained. Although differences in behavior were found in consequence of the experimental manipulations, it is not clear to what these differences should be attributed, i.e., what the conceptual referents of the experimental operations actually are. The descriptions of the groups' behavior offer reason to doubt that reading about the virtues of *gemeinschaftlich* behavior will produce such behavior, or even a strong belief in its virtues.

Lanzetta (77) studied the behavior of four-man groups working at reasoning and mechanical assembly tasks under two conditions of motivation, i.e., group monetary reward versus none, and three conditions of externally applied stress, i.e., none, time limit and frequent observer reference to time, and time limit plus badgering of subjects and restriction of their work space. Virtually no differences resulted from varying motivation, but stress increased group cohesiveness and decreased self-oriented and aggressive behavior. Performance was best under mild stress.

In an effort to isolate additional factors important in response to stress, Lanzetta *et al.* (78) studied the behavior of three-man groups of Air Force Reserve Officers' Training Corps and Naval Reserve Officers' Training Corps students on an aircraft interception problem which was represented to the subjects as providing a basis for evaluating them for purposes of their service records. The experiment used a  $2 \times 2$  design, involving an internal (self-rating) versus an external threat (rating by observers), and threat to group (same rating for all) versus threat to individual. Neither these variables nor their interaction produced any significant effects on group behavior. Hence these four series of groups were pooled and compared with a control series to which the experimental task was represented simply as an experiment. In contrast with these groups, the threatened groups showed better personal relations, less forceful attention to their task, lower efficiency, and greater variability in performance.

In a report of a study of group responses to more extreme, real life

stresses, Torrance (144) summarized the findings of interviews with about 200 Air Force personnel who were downed during World War II or the Korean War. Torrance's interpretation is that typically survival situations of this sort are little structured and that panic or hopelessness readily develops unless structure is introduced into the external field or into the groups. Specific ways in which this can be done are discussed and illustrated with case material.

#### CONCLUSION

The output of the past year has been prodigious. As in previous years much of this work is unintegrated. However, increasing signs suggest that, around a central focus provided by concepts of interaction and group process, social psychology is developing greater coherence and internal structure. Certain obvious highlights of the year can be pointed out, e.g., Lindzey's *Handbook*, several distinguished studies of voting behavior, Festinger's theory of comparison processes. Likewise areas of little or no reported progress are identifiable, e.g., mass media. But in most areas one is impressed not primarily by highlights or deficiencies but by a growing accumulation of good work on important problems. This is progress, and it looks as if it will continue.

#### LITERATURE CITED

1. Adams, S., *Am. Sociol. Rev.*, **19**, 421-25 (1954)
2. Adorno, T. W., Frenkel-Brunswik, E., Levinson, D. J., and Sanford, R. N., *The Authoritarian Personality* (Harpers & Brothers, New York, N. Y., 990 pp., 1950)
3. Allport, G. W., *The Nature of Prejudice* (Addison-Wesley, Cambridge, Mass., 537 pp., 1954)
4. Anderson, T. W., in *Mathematical Thinking in the Social Sciences*, 17-66 (Lazarsfeld, P. F., Ed., The Free Press, Glencoe, Ill., 444 pp., 1954)
5. Anderson, T. W., *Psychometrika*, **19**, 1-10 (1954)
6. Andrews, T. G., Smith, D. D., and Kahn, L. A., *J. Appl. Psychol.*, **38**, 240-44 (1954)
7. Bales, R. F., *Interaction Process Analysis* (Addison-Wesley, Cambridge, Mass., 203 pp., 1950)
8. Bales, R. F., in *Working Papers in the Theory of Action* (Parsons, T., Bales, R. F., and Shils, E. A., Eds., The Free Press, Glencoe, Ill., 269 pp., 1953)
9. Bass, B. M., *Psychol. Bull.*, **51**, 465-92 (1954)
10. Bavelas, A., *Appl. Anthropol.*, **7**, 16-30 (1948)
11. Becker, S. L., *Public Opinion Quart.*, **18**, 271-78 (1954)
12. Bennett, E. M., Alpert, R., and Goldstein, A. C., *Public Opinion Quart.*, **18**, 303-8 (1954)
13. Bennett, E. M., Blomquist, R. L., and Goldstein, A. C., *Public Opinion Quart.*, **18**, 218-23 (1954)
14. Berelson, B. R., Lazarsfeld, P. F., and McPhee, W. N., *Voting* (University of Chicago Press, Chicago, Ill., 395 pp., 1954)
15. Berkowitz, L., *Human Relations*, **7**, 509-19 (1954)

16. Blake, R. R., Mouton, J. S., and Fruchter, B., *J. Abnormal Social Psychol.*, **49**, 573-78 (1954)
17. Blake, R. R., Rosenbaum, M., and Duryea, R. A., *Human Relations*, **8**, 61-73 (1955)
18. Blau, P. M., *Human Relations*, **7**, 337-48 (1954)
19. Borgatta, E. F., Bales, R. F., and Couch, A. S., *Am. Sociol. Rev.*, **19**, 755-59 (1954)
20. Brim, O. G., Jr., *Am. Sociol. Rev.*, **20**, 68-76 (1955)
21. Brodbeck, A. J., and Perlmutter, H. V., *J. Psychol.*, **38**, 271-80 (1954)
22. Burchard, W. W., *Am. Sociol. Rev.*, **19**, 528-35 (1954)
23. Campbell, A., Gurin, G., and Miller, W. E., *The Voter Decides* (Row, Peterson and Co., Evanston, Ill., 242 pp., 1954)
24. Campbell, D. T., *Am. J. Sociol.*, **60**, 339-42 (1955)
25. Campbell, D. T., and Mohr, P. J., *J. Appl. Psychol.*, **34**, 62-67 (1950)
26. Cattell, R. B., and Stice, G. F., *Human Relations*, **7**, 493-507 (1954)
27. Chandler, M., *Human Organization*, **13**, 26-28 (1954)
28. Chowdhry, K., and Newcomb, T. M., *J. Abnormal Social Psychol.*, **47**, 51-57 (1952)
29. Davis, F. J., Hagedorn, R., and Larson, J. R., *Public Opinion Quart.*, **18**, 279-86 (1954)
30. Davitz, J. R., *J. Abnormal Social Psychol.*, **50**, 173-76 (1955)
31. DeGaugh, R. A., and Knoell, D. M., *Research Bull., AFPTRC-TR-54-18* (Crew Research Laboratory, Air Force Personnel and Training Research Center, Lackland Air Force Base, San Antonio, Texas, 1954)
32. de Monchaux, C., and Shimmin, S., *Human Relations*, **8**, 53-60 (1955)
33. Dreyer, A. S., *Human Relations*, **7**, 175-90 (1954)
34. Ekman, G., *J. Social Psychol.*, **41**, 149-62 (1955)
35. Emerson, R. M., *Am. Sociol. Rev.*, **19**, 688-93 (1954)
36. Festinger, L., *Psychol. Rev.*, **57**, 271-82 (1950)
37. Festinger, L., *Human Relations*, **7**, 117-40 (1954)
38. Festinger, L., and Hutte, H. A., *J. Abnormal Social Psychol.*, **49**, 513-22 (1954)
39. Festinger, L., Schachter, S., and Back, K., *Social Pressures in Informal Groups* (Harper & Brothers, New York, N. Y., 240 pp., 1950)
40. Festinger, L., Torrey, J., and Willerman, B., *Human Relations*, **7**, 161-74 (1954)
41. Fiedler, F. E., Warrington, W. G., and Blaisdell, F. J., *J. Abnormal Social Psychol.*, **47**, 790-96 (1952)
42. Fiedler, F. E., *J. Abnormal Social Psychol.*, **49**, 381-88 (1954)
43. Gerard, H. B., *Human Relations*, **7**, 313-25 (1954)
44. Getzels, J. W., *Public Opinion Quart.*, **18**, 80-91 (1954)
45. Getzels, J. W., and Guba, E. G., *Am. Sociol. Rev.*, **19**, 164-75 (1954)
46. Gibson, W. A., *Psychometrika*, **20**, 69-73 (1955)
47. Gilchrist, J. C., Shaw, M. E., and Walker, L. C., *J. Abnormal Social Psychol.*, **49**, 554-56 (1954)
48. Goldberg, S. C., *J. Abnormal Social Psychol.*, **49**, 325-29 (1954)
49. Greer, F. L., Galanter, E. H., and Nordlie, P. G., *J. Abnormal Social Psychol.*, **49**, 411-14 (1954)
50. Gross, E., *Am. J. Sociol.*, **60**, 24-29 (1954)
51. Grossack, M. M., *J. Abnormal Social Psychol.*, **49**, 341-48 (1954)
52. Guest, L., *Public Opinion Quart.*, **18**, 287-99 (1954)

53. Guetzkow, H., and Gyr, J., *Human Relations*, **7**, 367-82 (1954)
54. Guttman, L., *Intern. J. Opinion Attitude Research*, **4**, 285-87 (1950)
55. Guttman, L., in Stouffer, S. A., Guttman, L., Suchman, E. A., Lazarsfeld, P. F., Star, S. A., and Clausen, J. A., *Studies in Social Psychology in World War II*, Vol. IV, *Measurement and Prediction*, 312-61 (Princeton University Press, Princeton, N. J., 756 pp., 1950)
56. Guttman, L., in *Mathematical Thinking in the Social Sciences*, 216-57 (Lazarsfeld, P. F., Ed., The Free Press, Glencoe, Ill., 444 pp., 1954)
57. Harary, F., and Ross, I. C., *J. Social Psychol.*, **40**, 329-32 (1954)
58. Hare, A. P., and Davie, J. S., *Sociol. and Social Research*, **39**, 81-87 (1954)
59. Harris, E. F., and Fleishman, E. A., *J. Appl. Psychol.*, **39**, 20-25 (1955)
60. Hastings, P. K., *J. Psychol.*, **38**, 301-12 (1954)
61. Hays, D. G., and Borgatta, E. F., *Psychometrika*, **19**, 271-79 (1954)
62. Hays, D. G., and Bush, R. R., *Am. Sociol. Rev.*, **19**, 693-701 (1954)
63. Haythorn, W. W., *Research Bull.*, *AFPTRC-TR-54-104* (Crew Research Laboratory, Air Force Personnel and Training Research Center, Lackland Air Force Base, San Antonio, Texas, 1954)
64. Hochbaum, G. M., *Am. Sociol. Rev.*, **19**, 678-87 (1954)
65. Hoffman, P. J., Festinger, L., and Lawrence, D. H., *Human Relations*, **7**, 141-59 (1954)
66. Hollander, E. P., *J. Abnormal Social Psychol.*, **49**, 365-70 (1954)
67. Hollander, E. P., and Webb, W. B., *J. Abnormal Social Psychol.*, **50**, 163-67 (1955)
68. Hovland, C. I., and Sherif, M., *J. Abnormal Social Psychol.*, **47**, 822-32 (1952)
69. Humphreys, L. G., *J. Exptl. Psychol.*, **25**, 294-301 (1939)
70. Jahoda, G., *J. Abnormal Social Psychol.*, **49**, 330-34 (1954)
71. Janis, I. L., and Feshbach, S., *J. Abnormal Social Psychol.*, **48**, 78-92 (1953)
72. Janis, I. L., and Feshbach, S., *J. Personality*, **23**, 154-66 (1954)
73. Johnson, R. J., *J. Appl. Psychol.*, **38**, 320-23 (1954)
74. Kelley, H. H., and Shapiro, M. M., *Am. Sociol. Rev.*, **19**, 667-77 (1954)
75. Kilpatrick, F. P., and Garard, J. L., *Public Opinion Quart.*, **18**, 96-98 (1954)
76. Knoell, D. M., and Stice, G. F., *Research Bull.*, *AFPTRC-TR-54-63* (Crew Research Laboratory, Air Force Personnel and Training Research Center, Lackland Air Force Base, San Antonio, Texas, 1954)
77. Lanzetta, J. T., *Human Relations*, **8**, 29-52 (1955)
78. Lanzetta, J. T., Haefner, D., Langham, P., and Axelrod, H., *J. Abnormal Social Psychol.*, **49**, 445-53 (1954)
79. Lanzetta, J. T., and Haythorn, W. W., *Research Bull.*, *AFPTRC-TR-54-79* (Crew Research Laboratory, Air Force Personnel and Training Research Center, Lackland Air Force Base, San Antonio, Texas, 1954)
80. Lazarsfeld, P. F., in Stouffer, S. A., Guttman, L., Suchman, E. A., Lazarsfeld, P. F., Star, S. A., and Clausen, J. A., *Studies in Social Psychology in World War II*, Vol. IV, *Measurement and Prediction*, 362-412 (Princeton University Press, Princeton, N. J., 756 pp., 1950)
81. Lazarsfeld, P. F., in *Mathematical Thinking in the Social Sciences*, 349-87 (Lazarsfeld, P. F., Ed., The Free Press, Glencoe, Ill., 444 pp., 1954)
82. Lazarsfeld, P. F., Berelson, B., and Gaudet, H., *The People's Choice* (Columbia University Press, New York, N. Y., 178 pp., 1948)
83. Leavitt, H. J., *J. Abnormal Social Psychol.*, **46**, 38-50 (1951)

84. Lenski, G. E., *Am. Sociol. Rev.*, **19**, 405-13 (1954)
85. Levinson, D. J., *J. Psychol.*, **38**, 103-26 (1954)
86. Levy, B. I., *Research Bull., AFPTRC-TR-54-87* (Crew Research Laboratory, Air Force Personnel and Training Research Center, Lackland Air Force Base, San Antonio, Texas, 1954)
87. Lindzey, G., Ed., *Handbook of Social Psychology*, **I, II** (Addison-Wesley, Cambridge, Mass., 1226 pp., 1954)
88. Maccoby, E. E., Matthews, R. E., and Morton, A. S., *Public Opinion Quart.*, **18**, 23-39 (1954)
89. Marquart, D. I., *J. Social Psychol.*, **41**, 103-13 (1955)
90. Mausner, B., *J. Abnormal Social Psychol.*, **49**, 557-60 (1954)
91. Mills, T. M., *Am. Sociol. Rev.*, **19**, 657-67 (1954)
92. Moltz, H., and Thistlethwaite, D. L., *J. Abnormal Social Psychol.*, **50**, 231-37 (1955)
93. Moore, O. K., and Anderson, S. B., *Am. Sociol. Rev.*, **19**, 702-14 (1954)
94. Mouton, J. S., Blake, R. R., and Fruchter, B., *Sociometry*, **18**, 7-48 (1955)
95. Murchison, C. A., Ed., *Handbook of Social Psychology* (Clark University Press, Worcester, Mass., 1195 pp., 1935)
96. Olmstead, J. A., and Blake, R. R., *J. Personality*, **23**, 335-45 (1955)
97. Olmsted, M. S., *Am. Sociol. Rev.*, **19**, 741-51 (1954)
98. Osgood, C. E., and Tannenbaum, P. H., *Psychol. Rev.*, **62**, 42-55 (1955)
99. Payne, R. B., and Hauty, G. T., *J. Exptl. Psychol.*, **47**, 267-73 (1954)
100. Pearl, D., *J. Abnormal Social Psychol.*, **50**, 227-29 (1955)
101. Perlmutter, H. V., *J. Psychol.*, **38**, 291-300 (1954)
102. Perrine, M. W., and Wessman, A. E., *Public Opinion Quart.*, **18**, 92-98 (1954)
103. Prothro, E. T., *J. Social Psychol.*, **40**, 53-59 (1954)
104. Prothro, E. T., *J. Social Psychol.*, **41**, 11-17 (1955)
105. Prothro, E. T., and Melikian, L. H., *J. Social Psychol.*, **41**, 3-10 (1955)
106. Rasmussen, G., and Zander, A., *Human Relations*, **7**, 239-51 (1954)
107. Riley, M. W., Cohn, R., Toby, J., and Riley, J. W., Jr., *Am. Sociol. Rev.*, **19**, 715-24 (1954)
108. Roby, T. B., *Research Bull., No. 53-18* (Combat Crew Training Research Laboratory, Human Resources Research Center, Lackland Air Force Base, San Antonio, Texas, 1953)
109. Roby, T. B., *Research Bull., AFPTRC-TR-54-13* (Crew Research Laboratory, Air Force Personnel and Training Research Center, Lackland Air Force Base, San Antonio, Texas, 1954)
110. Roby, T. B., *Research Bull., AFPTRC-TR-54-69* (Crew Research Laboratory, Air Force Personnel and Training Research Center, Lackland Air Force Base, San Antonio, Texas, 1954)
111. Roby, T. B., and Rosenberg, S., *Research Bull., AFPTRC-TR-54-85* (Crew Research Laboratory, Air Force Personnel and Training Research Center, Lackland Air Force Base, San Antonio, Texas, 1954)
112. Rohrer, J. H., Baron, S. H., Hoffman, E. L., and Swander, D. V., *J. Abnormal Social Psychol.*, **49**, 595-97 (1954)
113. Rosen, B. C., *Am. Sociol. Rev.*, **20**, 155-61 (1955)
114. Rosenbaum, M., and Blake, R. R., *J. Abnormal Social Psychol.*, **50**, 193-96 (1955)
115. Rosenberg, S., and Curtiss, J., *J. Abnormal Social Psychol.*, **49**, 355-61 (1954)



116. Saenger, G., and Flowerman, S., *Human Relations*, **7**, 217-38 (1954)
117. Schachter, S., *J. Abnormal Social Psychol.*, **46**, 190-207 (1951)
118. Schachter, S., Ellertson, N., McBride, D., and Gregory, D., *Human Relations*, **4**, 229-38 (1951)
119. Schachter, S., Nuttin, J., de Monchaux, C., Maucorps, P. H., Osmer, D., Duijker, H., Rommetveit, R., and Israel, J., *Human Relations*, **7**, 403-39 (1954)
120. Schein, E. H., *J. Abnormal Social Psychol.*, **49**, 389-95 (1954)
121. Shaw, M. E., *Am. J. Psychol.*, **44**, 491-504 (1932)
122. Shaw, M. E., *J. Psychol.*, **38**, 139-49 (1954)
123. Shaw, M. E., *J. Exptl. Psychol.*, **48**, 211-17 (1954)
124. Shaw, M. E., *J. Abnormal Social Psychol.*, **49**, 547-53 (1954)
125. Shaw, M. E., *J. Abnormal Social Psychol.*, **50**, 127-34 (1955)
126. Shaw, M. E., and Gilchrist, J. C., *J. Abnormal Social Psychol.*, **50**, 29-32 (1955)
127. Shelley, H. P., *J. Social Psychol.*, **40**, 149-64 (1954)
128. Sherif, M., White, B. J., and Harvey, O. J., *Am. J. Sociol.*, **60**, 370-79 (1955)
129. Simon, H. A., *Public Opinion Quart.*, **18**, 245-53 (1954)
130. Simon, H. A., and Guetzkow, H., *Psychol. Rev.*, **62**, 56-68 (1955)
131. Singer, J. L., and Goldman, G. D., *J. Social Psychol.*, **40**, 23-37 (1954)
132. Stagner, R., *J. Social Psychol.*, **40**, 197-210 (1954)
133. Steiner, I. D., *J. Abnormal Social Psychol.*, **49**, 349-54 (1954)
134. Steiner, I. D., *Am. Sociol. Rev.*, **19**, 260-67 (1954)
135. Tagiuri, R., Bruner, J. S., and Kogan, N., *Psychol. Bull.*, **52**, 122-31 (1955)
136. Talland, G. A., *J. Abnormal Social Psychol.*, **49**, 431-34 (1954)
137. Talland, G. A., *J. Abnormal Social Psychol.*, **50**, 105-9 (1955)
138. Taylor, F. K., *Human Relations*, **7**, 441-71 (1954)
139. Taylor, F. K., *Human Relations*, **8**, 3-28 (1955)
140. Thelen, H. A., *Dynamics of Groups at Work* (University of Chicago Press, Chicago, Ill., 379 pp., 1954)
141. Thrall, R. M., and Angell, R. C., *Sociometry*, **17**, 244-71 (1954)
142. Thrasher, J. D., *Sociometry*, **17**, 228-41 (1954)
143. Torrance, E. P., *Research Bull., AFPTRC-TR-54-128* (Crew Research Laboratory, Air Force Personnel and Training Research Center, Lackland Air Force Base, San Antonio, Texas, 1954)
144. Torrance, E. P., *Am. Sociol. Rev.*, **19**, 751-55 (1954)
145. Vidich, A. J., and Shapiro, G., *Am. Sociol. Rev.*, **20**, 28-33 (1955)
146. Waisanen, F. B., *Public Opinion Quart.*, **18**, 210-12 (1954)
147. Wallace, D., *Public Opinion Quart.*, **18**, 40-52 (1954)
148. Westie, F. R., and Howard, D. H., *Am. Sociol. Rev.*, **19**, 584-91 (1954)
149. Willerman, B., *Psychol. Bull.*, **52**, 132-33 (1955)
150. Wilson, R. C., High, W. S., Beem, H. P., and Comrey, A. L., *J. Appl. Psychol.*, **38**, 89-92 (1954)
151. Wilson, R. C., High, W. S., and Comrey, A. L., *J. Appl. Psychol.*, **39**, 85-91 (1955)
152. Winch, R. F., *The Modern Family* (Henry Holt & Co., Inc., New York, N. Y., 522 pp., 1952)
153. Winch, R. F., *Am. Sociol. Rev.*, **20**, 52-56 (1955)
154. Winch, R. F., Ktsanes, T., and Ktsanes, V., *Am. Sociol. Rev.*, **19**, 241-49 (1954)
155. Winder, A. E., *J. Social Psychol.*, **41**, 85-102 (1955)
156. Withey, S. B., *Public Opinion Quart.*, **18**, 197-204 (1954)

## ABNORMALITIES OF BEHAVIOR<sup>1,2</sup>

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A review which is to be selective and critical demands bias of the author. Readers may be afforded a facilitating orientation if the reviewer states which biasing factors determine his selection. This reviewer has favored investigation over conjecture, studies of clinical samples have been favored over analyses of single cases, works dealing with major pathology as defined by numbers of persons affected have had preference over studies of phenomena with lesser import for social economy, and researches which have reported significant innovations in methodology have received priority over those of duplicative nature. Finally, the area reviewed has been delimited by a definition of abnormalities of behavior as: molar symptoms or syndromes which interfere with the biologic, economic, or social well-being of the human or with social welfare or both, or are manifestations of such interference.

In compiling materials for review, a simple code was applied which indicated for each study (a) the nature of the abnormality; (b) whether it constituted an experimental research, clinical investigation, or theoretical paper; and (c) whether the content referred primarily to etiology, diagnosis, therapy, or prognosis. This coding permitted a survey of relative research concentration reflected in the over 230 articles reported in 17 journals. Over half of all studies were concerned with psychoses; these were nearly equally composed of experimental studies and clinical investigations. Of all journal reports, only 36 per cent were of an experimental nature, while nearly 50 per cent were nonexperimental investigations of clinical groups. Clinical investigations of therapies of the psychoses constituted the most frequent of all specifically defined reports. By contrast, theoretical papers on organic brain syndromes and on psychosomatic disorders were noticeably few.

### THE PSYCHOSES

*Major research.*—A major research program into the etiology and therapy of schizophrenia is introduced by the Tulane group in a series of papers edited by Heath (1). In view of the awesome size of this volume, it is discouraging to find that it does not contain definitive answers to the problems of either cause or treatment. However, it is a model of scientific reporting in which the difficulties of experimental technique are given full exposition, and the

<sup>1</sup> The survey of the literature pertaining to this review was completed in April, 1955.

<sup>2</sup> The following abbreviations are used in this chapter: ECT (electroconvulsive therapy); EEG (electroencephalograph); MMPI (Minnesota Multiphasic Personality Inventory).

persistence of unresolved technical frustrations are freely acknowledged. A most conservative appraisal is given of the degree to which the clinico-experimental data support the theoretical formulation and suggest a truly therapeutic maneuver. Finally, the value of the report is enhanced by full presentation of the critiques of 10 experts from different disciplines.

Workers who prefer their theory in the form of a closely reasoned, hypothetico-deductive system will be dissatisfied with the rather loosely-organized pattern of phylogenetic, neurologic, biochemical, and psychologic observations out of which Heath develops a "theoretical framework." Briefly, adaptation and integration of behavior at higher levels are seen as dependent upon normal development and intact functioning at lower levels of the neuraxis, with these lower levels seen as mediating the feeling capacity of the individual. Failure of hedonic function is viewed as the primary defect in schizophrenia. It is observed that stimuli to the prefrontal and temporal cortex fire the septal region (for which the landmarks are carefully specified) and that stimuli to the septal region activate the cortex. Further observation that electric impulses to the septal regions in cats and monkeys induced immediate and markedly opposed states of alertness or somnolence led to the conception of facilitatory and inhibitory circuits contributing to the hedonic adaptation presumed to underlie neuropsychological evolution of symbolism. It is hypothesized that a pathologically reverberating cortico-septal circuit is triggered by stressful stimuli received at the cortex and that electric stimuli to the base of the septal region could disrupt the pathological inhibition and facilitate more normal cortical activity.

Selected for exploratory testing of this theory of schizophrenic disorder were 20 chronic patients who had not responded to insulin or ECT. Duration of illness ranged from one and a half to over 20 years with a median of approximately four years. Catatonic, hebephrenic, and paranoid types had essentially equal representation. All 20 patients were considered poor bets for psychosurgery. Eight of the patients had associated medical problems such as hypertension and tuberculosis, and two were considered to be possible mental defectives. Only three of the patients had shown any promise of spontaneous remission. The basic technique of study and treatment involved the implantation of electrodes in the septal region (in most cases by stereotaxic technique), with these leads subsequently used to obtain subcortical EEGs and to administer microcurrents to the septal region. Skull rays were taken to provide check on the localization of electrodes. Following implantation, extended records were made of intra-arterial blood pressure, skin temperature, and other physiological functions and of the response of these to subcortical stimulation. In addition, a battery of psychological tests including measures of intellect and personality was administered approximately two weeks preoperatively and three months postoperatively. Systematic behavior ratings were periodically recorded.

A major and most intriguing finding was that of "spiking" activity in the

subcortical EEGs of schizophrenics whose scalp and direct cortical EEGs preoperatively revealed no comparable spikes. Stimulation through the leads from which subcortical spikes had been recorded resulted frequently in diminished frequency, reduced amplitude, or disrupted form of these spikes; but such alterations of this subcortical activity rarely persisted more than two hours post-stimulation. Septal stimulation produced a brisk autonomic response of a primarily sympathetic nature. General evaluation of the psychological test data revealed no consistent response to the procedure. Immediate reactions of the patients to stimulation took the form of increased alertness, diminished preoccupation with delusions, and extinction of bizarre mannerisms, followed by a period of lethargy and dulled affect on the second or third postoperative day. This in turn gave way to a steady improvement of three to six weeks in duration in all patients. With a follow-up period of 15 to 36 months, of the 20 patients: there were two deaths; ten patients were discharged, and nine of these have remained on an outpatient basis, the remaining dischargée having died one and a half months post-discharge; 13 are considered clinically to reveal significant improvement. Of the total experimental group, it is estimated that discharge, in the absence of intervention, would have been predicted for not more than four.

Enthusiasm over these encouraging results is tempered by the recognition by Heath and his co-workers that the effects of subcortical stimulation were deliberately contaminated postoperatively by a "total push" program designed to support and increase the improved affective responsiveness and alertness of the patient. The limited generalization from outcome data on a sample of 20 is obvious. Aside from evaluation of the procedure as therapy, the technical difficulties (impossibilities?) of accurate stereotaxic localization of electrodes, the problems of subcortical electroencephalography, and the apparently temporary nature of the disruption of subcortical spikes make it impossible to conclude that the theory of inhibitory-facilitatory dysfunction and hedonic deficit as basic to schizophrenia is either supported or weakened. It seems likely that the Tulane group will be less rewarded for their contribution to theory than for their courage and carefulness in executing a daring procedure and for their meticulous reporting of technical frustration and experimental success.

A very valuable side-product of the Tulane project is a volume by King (2) reporting normative data on a battery of three psychomotor tests which were administered to samples of normals, psychotics, and "subacute disorder" cases. The three tests yielded four basic measures of reaction time, a measure of speed of tapping, and a measure of finger dexterity. The normals included 104 males and 90 females in the 20 to 70 age range. The psychotics were 45 male and 45 female chronic schizophrenics with a median of nine years of hospitalization. The subacute group included 27 pseudoneurotic schizophrenics and 23 neurotics. There is excellent tabular and graphic reporting of the basic data which clearly illustrate the diagnostic potential of

psychomotor function. The degree to which level of psychomotor function reflects over-all clinical status is illustrated not only by the chronic-subacute comparisons but by the relationship of test scores to three separate indices: (a) hospital-ward placement, (b) psychiatric ratings on the Malamud-Sands (3) scale, and (c) psychological ratings on a 14-item scale pertaining to response to the test situation. On the average, the performance of the schizophrenics approximated only 50 per cent of the value for normals, while the subacute group achieved roughly 88 per cent of the normal index. The ratio of simple to disjunctive reaction time was approximately equal for the normal, chronic, and subacute samples; practice learning curves were highly comparable for the three groups. A review of the related researches of other workers is provided, and the implications of the consistent findings of psychomotor disorder in mental illness are traced. The utility of psychomotor measures as indices of therapeutic response is but one of the many possibilities warranting extended investigations. The psychomotor aspects of mental illness have been overshadowed far too long by the perhaps more fascinating aspects of mental content and dynamics. King's book should serve to stimulate renewed attention to an area of psychological function which must be included in any thorough organismic approach to behavior pathology.

Beck (4) reports the results of two researches conducted at Michael Reese Hospital in 1947 to 1952. These were concerned with patterns of psychosis or levels of involvement in adult schizophrenics and with the course of psychosis in schizophrenic children. For purposes of the first research, psychiatrists and psychologists used an outline for recording the basic data of personality under headings of: defenses, ego, emotional forces, and restitutional forces. This outline evolved out of prolonged, recurrent staff conferences devoted to the problem of defining schizophrenia. This detailed outline was reduced by Professor William Stephenson to a schizophrenic universe of 120 items suitable for *Q*-sorting. A *Q*-sort was made independently by a psychiatrist and by each of two Rorschach test investigators for 20 patients (12 adults and 8 children), who had been diagnosed as schizophrenic some 10 or more years prior to this research. The original diagnoses had been based on all available data, which in some cases included the Rorschach test report. The contaminating effect of having the psychiatric diagnoses occasionally based in part on Rorschach evaluations is acknowledged by Beck. One presumes that the *Q*-sort by the psychiatrist was based on the usual psychiatric data exclusive of the Rorschach and that the *Q*-judgments by the test investigators were based exclusively on the Rorschach. The need to avoid contamination at this point is so obvious that one must presume this is why the specific provisions which were made to assure non-contamination are not explicitly stated. The Rorschach records on which the *Q*-sorts were based had been rescored in terms of normative data obtained from 157 adult "volunteer" employees of a Chicago mail-order house. In view of the psychological selectivity of volunteers, there is serious question as to

whether data from such a group adequately define statistical "norms" and boundaries of pathology.

Inspection of the 20 sets of three sortings each led to separation into two groups: (a) 12 patients for whom the *Q*-sorts of psychiatrist and Rorschach worker appeared in agreement and (b) eight patients for whom there was disagreement. Intercorrelations of the sortings and subsequent factor analysis were carried out separately for these two groups and led to the isolation of six reaction patterns, three from each group. The Rorschach pattern and *Q*-structure of each schizophrenic pattern are reported in detail. As appears frequently to be the case, the precision of mathematical identification of factors (or patterns) afforded by factor analytic technique is not paralleled by comparable precision in descriptive distinction. For example, Beck reports two of the schizophrenias to show a primary loading with intellectual disruption, with relative use of fantasy as the important differential. A third pattern is notable for being one to which patients turn from some other schizophrenic pattern.

In the second project, Beck selected 20 schizophrenic children for each of whom there were two Rorschach protocols with an intertest interval of not less than one year. The median interval was six years. *Q*-technique was applied in the usual fashion in deriving a description of each Rorschach personality. On the basis of these data, Beck found that all children retained some form of schizophrenic pattern and concluded that schizophrenia is "a permanent character structure," although he acknowledges that a "non-schizophrenic could not be fully described by our present universe of traits." The frequency of various patterns of change in terms of the six schizophrenias is reported with the interesting finding that two of the severe patterns are not found under age eleven, while two other patterns if present initially are "never" retained (n.b.,  $N=20$ !).

Students of the Rorschach will appreciate the general normative material which Beck reports in extensive appendices. Basic scores are reported for samples of normals, schizophrenics, and neurotics, separately for adults and children.

*Descriptive surveys.*—McAuley (5) has written a moderately discursive, noncritical overview of the subject of schizophrenia intended primarily for the general physician or student contemplating specialization. One wonders about the general accuracy with which authorities are quoted when one reads of the "interesting experiments of Beck and Rorschach (1938) . . . they came to the following conclusions."(!)

Several census studies reveal interesting patterns of stability and change in the characteristics of psychiatric populations. Malzberg (6, 7) reports detailed data for New York state-hospital patients. Comparing the first admissions during 1919 to 1921 with those of 1949 to 1951, he finds increases in the annual rates per 100,000 of the general population of each sex from 67.8 to 108.1 for males and from 62.5 to 102.9 for females. Over the 30-year interval

the median age of first admissions had increased from 40.5 to 52.1. Patients over age 60 constituted only 19.1 per cent of first admissions during the earlier period but 40.0 per cent in the later period. Psychoses with cerebral arteriosclerosis tripled in their proportional representation, the proportion of cases diagnosed dementia praecox remained stable (29 per cent), and both general paresis and manic-depressive psychoses showed notable decreases.

Roberts & Myers (8) analyzed the relation of religion, national origin, and immigrational status to the prevalency of various mental disorders by a survey of all psychiatric patients in the metropolitan area of New Haven (Connecticut), who were under treatment on December 1, 1950. A total of 1,963 cases was found for which basic data were provided by psychiatrists or hospital personnel. With religious affiliation recorded as Catholic, Protestant, or Jewish, these groups revealed frequencies of schizophrenia, affective psychoses, psychoses with mental deficiency, and illnesses of senescence directly proportional to the representation of each religion in the general population. The Jews contributed a disproportionate number to the total psychiatric population, an excess largely accounted for by a rate of neurosis two and a half times that expected. By contrast, Catholics gave inordinately elevated rates for "alcohol and drug addiction," a category having no representation among the Jews. The foreign-born contribute a disproportionate but small number to the total psychiatric population, this excess contributed chiefly in the categories of affective disorder, senescence, and organic syndromes. While native-born accounted for 77 per cent of the total psychiatric population, they accounted for 93.2 per cent of the neuroses. The authors discuss the influence on differential rates of psychoneurosis of the relative acceptance of psychiatry and psychoanalytic theory by Jews as contrasted with Catholics.

Benedict & Jacks (9) provide a useful summary of the data available on the incidence and forms of functional psychoses in primitive peoples. They point out that depressive states appear to be rare in native populations and that the schizophrenia of primitive groups conforms poorly to Western nosology, but they conclude that existing data are very inadequate in answering basic questions of comparative psychiatry.

*Psychopathology of schizophrenia.*—Several experimental attacks on the psychopathology of schizophrenia are reported. Peters & Murphree (10) hypothesize that an aspect of the schizophrenic syndrome is a "functional decortication" (comparable to Pavlov's "inertia") and that a prolonged period of forced cerebration should improve general functioning. Normals and a control patient group were compared with a sample of schizophrenics who had been through a three month program of experimental problem-solving under motivation of insulin-stimulated hunger. Rapidity and amplitude of psychogalvanic-reflex conditioning were the critical measures. Both normals and the treated schizophrenics showed greater reactivity than the patients who had not received the "learning" stimulation. Appropriately, the authors



suggest a therapeutic benefit from any activity which forces the patient to use his cortex and do not think of their problem-solving program as a specific remedy.

Michaux (11) tested Hoskins' principle of defective somatic and psychic homeostasis by hypothesizing that schizophrenics would fail to show the relationship of apperceptive response to motivation which has been demonstrated for normals. Using samples of 48 adult male schizophrenics and 48 control males with negative psychiatric histories, it was found that a reliable increase over satiation levels in the number of food responses to incomplete words was manifested by the controls when hungry, while the schizophrenics revealed no alteration. Failure of the schizophrenics to show apperceptive adaptation is interpreted as attributable to a defect in "psychological homeostasis."

Wertheimer (12), noting the general agreement as to inefficiency of schizophrenic metabolism and the theory of figural after-effect as representing polarization of portions of the brain on which a contour is projected, predicted that schizophrenics would reveal smaller figural after-effects than normal controls. A test of this hypothesis, using samples of 15 male patients and 15 male controls reasonably well matched for age, led to confirmation.

Epstein (13) reports an interesting investigation of the self-judgments of schizophrenics and matched controls when presented with samples of their own expressive behavior disguised so as to prevent identification. Samples of speech, handwriting, and drawing were judged by each subject. Two judgments were made for each sample: degree of "liking" for it and degree of similarity to subject's own behavior. The unconscious self-ratings were generally more favorable than the judgments of others; the judgments of similarity were positively related to favorableness of unconscious self-rating; schizophrenics evaluated themselves more highly than did the normals in the "unconscious" judgments. In view of the delusional expansion suggested by the last finding, it is unfortunate that the author does not report the diagnostic composition of his schizophrenics.

Jenkins (14) attempts an hypothesis to account for the pathology of schizophrenia and for the fact that each of four differentiated therapies offers a degree of success. Briefly, schizophrenia is seen as progressive maladaptation resulting from conflict; conflict is defined as simultaneous activation of two or more incompatible neural pathways; corticodiencephalic feed-back mediates anxiety; and persistence of conflict and blocking of neural discharge lead to diffuse mentation. Psychological, psychosurgical, and environmental therapies are rationalized in light of their effect in resolving conflict, reducing feed-back, and activating further cortical resources respectively. There is little to quarrel with in this formulation except that Jenkins fails to state in what way it is specific to schizophrenia rather than providing a fairly general phenotypic description of all psychopathology. Within this framework, the specifics of schizophrenia could be suggested to

be: (a) hereditary deficit in resolving-power of the cortex; (b) hereditary "weakness" of synaptic resistances in the corticodiencephalic circuits, i.e., enhancement of feed-back effect; (c) specific content of conflict, e.g., oral incorporation versus need dependency; (d) occurrence of a series of "valance" experiences which fatigue or exhaust the individual's capacity for conflict resolution; or (e) a combination of these which is peculiar to schizophrenia and different from that for other psychoses or neuroses. The fact that all manner of operations from psychoanalysis through transorbital lobotomy have an about equal ineffectiveness as therapies of schizophrenia could suggest that a search for the common denominator of these equally poor procedures might provide a clue as to the nature of the disease. It seems simpler to account for their equal failure by referring to the fact that the essential etiology of schizophrenia remains unknown.

Freeman & Grayson (15) review the literature on the psychogenetic influence of maternal attitudes and report the results of application of the Shoben Parent-Child Attitude Survey to the mothers of 50 veteran schizophrenics and 50 control mothers. They hypothesized that the schizophrenic mothers would show generally poorer parent-child attitudes, more dominating attitudes, more dogmatic and more inconsistent attitudes. None of these predictions was supported at the usual levels of significance. The schizophrenic mothers did reveal a reliably greater tendency toward an "ignoring" attitude. Analysis of the 148 items revealed only 14 which differentiated the two groups; these items suggested that the mothers of schizophrenics had attitudes of martyrdom, subtle domination, and marked over-concern with their children's sexual behavior.

Whiteman (16) contrasts the views of Cameron and Goldstein as to the nature of the thinking impairment of schizophrenics. He applied three tests (verbal analogies, picture reasoning, and social concepts) to schizophrenics and controls matched on the basis of age, education, and Wechsler-Bellevue vocabulary. From Cameron's notion of social disarticulation in schizophrenia, Whiteman hypothesized that his patients would show greater relative decrement on tests of social concepts than on formal concepts when contrasted with normals. Significant differences in favor of the controls were found on both types of tests, but the superiority of the normals was greatest on the test of social concepts and was maintained when patients and normals were matched for performance on the formal concept tests.

*Diagnostic studies.*—Peterson (17) reports an investigation of signs of "subclinical schizophrenia." Thirty-three patients whose diagnoses as clinic outpatients made no reference to any form of schizophrenia, but who subsequently were hospitalized and given a schizophrenic diagnosis, were compared with: (a) a sample of 27 "true positives," clinic patients who were diagnosed as having "latent," "incipient," or "subclinical" schizophrenia and were subsequently hospitalized for schizophrenic psychosis; and (b) a sample of 33 "true negatives," patients without a clinic diagnosis of schizo-

phrenia and without subsequent hospitalization. No differences in age, education, intelligence, or mean MMPI test scores were found. When statistical analysis was applied to the occurrence of six different configural patterns of MMPI scores considered to indicate "psychosis," it was found that all six signs reliably differentiated the false negatives from the true negatives. Applying unit-scoring for the presence of each psychotic sign and a cutting score between one and two, 88 per cent of the false negatives would have been correctly "prediagnosed" at the expense of misidentification of 39 per cent of the true negatives. Peterson's study well illustrates the potential contribution to diagnostic refinement of careful review of false diagnoses.

Ellingson (18) provides a much needed review of the existing status of knowledge concerning the relationship of brainwave abnormality to functional mental disorder. In 11 reports on controls, the rate of abnormal EEGs varied from 5 to 20 per cent, with clustering around a value of 15 per cent. Comparable ranges are 9 to 60 per cent in schizophrenia, 2 to 34 per cent in psychoneurosis, and 7 to 12 per cent in psychosomatic disorder. The rates reported for undifferentiated psychopaths range from 15 to 58 per cent and from 2 to 92 per cent for behavior-problem children. After a review of the chief hypotheses which have been suggested to account for the higher than normal rates of EEG pathology in various mental patients, Ellingson concludes:

An abnormal EEG, especially if focal, paroxysmal, or severe diffuse abnormality is present, still suggests first an organic brain disorder, and such should be tentatively presumed to exist and be carefully checked out. Beyond differentiating the few organic cases which will be found, the EEG is of no value in the differential diagnosis of mental disorders or in personality assessment at the present time.

Brockway *et al.* (19) investigated the degree of homogeneity of four samples of so-called "control" subjects on a battery of psychiatric and psychological measures and the EEG. The total control group of 151 young males was drawn from National Guard units, Army Finance School recruits, Air Force cadet applicants, and a church discussion group and was contrasted in toto and by subgroup with a sample of 40 anxiety patients. The control samples revealed extensive heterogeneity on many of the psychological and psychiatric variables, with significant intergroup differences. The danger of considering a single source to provide an adequate random sample of normals is well illustrated together with the need for specifying the nature of all attributes of the control sample which might bear relationship to critical variables being studied. This study indicates the obvious need for a "Bureau of Psychological Standards," an idea first suggested to the reviewer by Professor D. G. Paterson over 12 years ago. It is simply amazing that we have approached this methodological necessity not even *à petit pas*.

Jenkins & Lorr (20) report the isolation of seven syndromes based on application of 54 rating scales to a sample of 423 male psychotic veterans.

The degree to which their "type-tracking" maneuvers have resulted in descriptions of patient groups bearing high similarity to those uncovered by Wittenborn's (21) more orthodox factor analyses causes wonder as to whether (hopefully!) the agreement reflects "real" patterns of pathological dysfunction, or simply (as is more obviously possible in the Jenkins-Lorr approach) the statistical teasing out of groupings that were imposed by the original selectivity of the units of observation. Jenkins & Lorr explicitly recognize this difference between the discovery of a configuration and the clarification of a preconceived factor.

When orthodox factor analytic techniques were applied by this same research group (22) to the intercorrelations of 55 ratings received by the same patients, 11 oblique first-order factors were derived. These workers acknowledge that their original schedule was designed to reflect 12 hypothesized factors, and we have another illustration of the use of factor analytic techniques to arrive at mathematical definitions of preconceived factors. Though this approach does not per se establish the "core" quality of the derived factors, the precision of definition permits subsequent observation and check as to the functional homogeneity of patients "diagnosed" by factor pattern. Regardless of procedural weaknesses which open the factor analytic findings of the Wittenborn and Lorr-Jenkins researches to avoidable criticisms, they are providing the first hope for a sound nomenclature since 1900. Factor analysis may not prove the royal road to nosology; but the objective, quantified observations used in these studies illustrate the necessary first step toward a scientific psychopathology.

Irvine (23) found the critical flicker frequency for paretics to be reliably lower than that of schizophrenics with whom they were matched for age, length of hospitalization, and extent of psychotic involvement. The difference in means was only 4 c.p.s., however, and the overlap of the two groups was too great to give the critical flicker frequencies diagnostic significance.

*Therapeutics.*—Two papers report the results of psychological pressure on chronic schizophrenics. Peters & Jenkins (24) subjected 10 chronic schizophrenics to individual sessions of performance-type problem solving with fudge as a reward. Subshock insulin injections induced a hunger motive. The program was followed five days a week for three months. Control groups were used to isolate effects of insulin and special attention. Decrease in number of ward incidents and improvement in nurses' and occupational therapy ratings for the experimental group were considered to justify extended study of this technique of "reactivation."

Kamman *et al.* (25) report a follow-up evaluation of the status of schizophrenic patients one year following discharge from a "total-push" program to which there had been a significant immediate response. The males who had manifested a reliable degree of improvement initially retained their gains while the females regressed to their pretreatment levels. It is suggested that this sex difference is accounted for by better posttreatment placement for the males.

David (26) reviewed 20 years of research on insulin therapy in schizophrenia and concluded that published evidence is "inconclusive and contradictory." Lifschutz (27), in a study designed to meet many of David's criticisms and suggestions, reports on insulin coma-therapy administered to 89 patients with well matched controls. Improvement rates were slightly higher in the control group; catatonics without insulin showed twice as high a remission rate as those who received treatment.

Brannon & Graham (28) report on a five-year experience with "intensive" insulin therapy on a total of 528 veteran patients. Functional recovery varied from 47.4 per cent to 71.3 per cent in the schizophrenics, and from 77.7 per cent to 100 per cent in manic-depressives.

In a well designed study, Coleman & Hellman (29) randomly assigned 60 male paranoid schizophrenics, all under age 40, to two treatment groups, insulin coma (ICT) and electronarcosis (EN). All patients were given a battery of psychological tests [Wechsler-Bellevue Scale, Wechsler Memory Scale, Shipley-Hartford, and exercises from Wells & Ruesch (30)] and a psychiatric appraisal prior to treatment and two weeks after therapy. There was not a reliable difference in the number of patients who improved under the two therapies. However, ICT was followed by nearly universal improvement in test scores while EN was followed by significant losses in most test areas.

Bond (31) reports five-year follow-up data for patients admitted to the Pennsylvania Hospital during 1925 to 1934 and 1940 to 1946. As a result of continuity of major staff between 1925 and 1949, diagnostic and evaluative criteria have remained reasonably constant, and the general physical environment has not changed. The earlier interval provides a control series for evaluating the general effects of the insulin and electroshock therapies introduced in 1935 to 1939. The analysis is a broad one, with no attempt to match patients in the two series for any variables which might relate to outcome. Not all patients in the 1940 to 1946 interval received either insulin or ECT. In the earlier period, 13 per cent of the schizophrenics were recovered or much improved five years following admission; in the more recent period, this figure is 23 per cent. Comparable improvement in recovery rates is found for the involutional group. By contrast, the recovery rates of the two periods are nearly equal for the manic-depressive patients, although introduction of ECT halved the average duration of hospitalization. Bond observes that recoveries in the control series appeared more stable than those in the shock-treated series.

Four papers report on outcomes in lobotomy. Freyhan (32) reports on 71 prefrontal lobotomies and 104 transorbital leucotomies. A majority of the patients in both series were chronic schizophrenics and had failed to respond to courses of ECT, insulin, or a combination of these. The age distribution was relatively equivalent in the two groups with a mode in the 30 to 40 interval. With follow-up intervals ranging from six months to five years, roughly a fourth of each series is at home and an additional 12 to 14 per cent

are improved. However, there was a 12.7 per cent operative death-rate in the lobotomy group in contrast to only 1.9 per cent in the transorbital series. Duration of illness preoperatively had the usual prognostic import in both groups.

Jackson & Jaco (33) report on 538 transorbital lobotomies which yielded an improvement rate of 57 per cent. Fifty-three per cent were discharged from the hospital, but only 31 per cent remained outside. Eighteen psychiatric and sociologic factors were appraised for their prognostic significance. Negroes, females, and involuntal and schizophrenic patients showed good response as did patients with brief illness, brief hospitalization, few ECTs.

Jenkins, Holsopple, & Lorr (34) used a variety of rating scales, test scores, and judgments to match rigidly a series of lobotomized schizophrenics with a control group of patients for severity of illness and nature of symptomatology. Fifty per cent of the operated cases are recorded as definitely improved in contrast to only 23 per cent of the matched controls. The source of the criterion data is not indicated. In a separate report (35), these workers are concerned with the nature of changes observed in the lobotomized patients as contrasted with their controls ( $Ns=125$  each). Basic data were 81 brief, descriptive ratings obtained from interview and ward observation, preoperatively and three months postoperatively. Centroid factor analysis was carried out separately on the intercorrelation matrices of scale-score changes of the operatees and controls respectively. Each analysis resulted in four factors of change which appeared highly similar. The authors conclude that lobotomy appears to enhance improvement in schizophrenia along the same dimensions of change which characterize improvement in nonoperated patients.

Medina, Pearson & Buchstein (36) report an eight-and-one-half year postoperative follow-up study of 43 prefrontal lobotomies. Thirty-three of the patients were schizophrenic. Thirteen were considered to show marked improvement while an additional seven were considered recovered, a total of nearly 50 per cent. When 25 of the operatees were matched for diagnosis, age at operation, age at hospitalization, and years of formal schooling with 25 controls, it was found that there were no recoveries in the controls and only one marked improvement, while the operated sample had 10 marked improvements and one recovery. Ten of the operatees were continuing to improve as late as eight years postoperatively.

In light of the mutilative, nonreversible, and generally extreme nature of psychosurgical procedures, it is reassuring to find that the great majority of patients submitted to these assaultive therapies have been carefully selected by a process of exclusion, i.e., they have represented cases of extended chronicity, extreme symptomatology, and absence of response to other therapies. Such completely negative selection, however, leaves much to be desired and if frontal lobe cutting has any specific therapeutic effect, it would be desirable to select patients having positive prognosis for the procedure.



Mettler *et al.* (37) report results for 21 patients submitted to topectomy in the third and final Columbia-Greystone project. An "occlusive index" was found to be of prognostic import. This index expresses the relative amount of time which the preoperative patient has spent outside of the hospital since his admission and is interpreted as a dual function of the patient's ability to relate to his environment and, to a lesser extent, of the quality of support offered by the family. Psychiatric ratings of intactness of affect and psychological tests of retention of perceptual capacity proved useful in identifying patients with severely reduced relational ability, while social-worker interviews appraised "occluding environments." The smaller the number of extramural visits of at least two weeks' duration in relation to the numbers of months of hospitalization, the poorer the probability of post-surgical discharge. The "occlusive index" is useful for identification of groups, as in selecting controls, but appears unsuitable to individual prediction.

Landis & Hamwi (38) compared the preoperative mental content of six topectomized patients who were discharged and remained well at least two years with that of six patients who were unimproved. The two groups were matched for age and IQ, and all patients were diagnosed as having schizophrenia. The improved group was characterized by symptoms and complaints of the "pseudoneurotic" variety in contrast to the unimproved patients who revealed the hallucinatory, delusional, confused content of classical schizophrenia.

The failure so far to establish that surgical insult on the frontal lobes produces a specific therapeutic effect has not deterred the development of further techniques for impairing man's most highly evolved organ. Lindstrom (39, 40) reports on the use of ultrasonic irradiation as a substitute for lobotomy. A frequency of 1000 kc. per sec. with an intensity averaging 7 w. per sq. cm. close to the output was administered through bilateral trephine openings to 20 patients, 16 with intractable pain from malignant metastases. Fourteen necropsies revealed histological damage in the path of the beam localized mainly in the white matter. It is claimed that damage can be controlled and graded from reversible effect to gross subcortical damage without unintentional mutilation. McIntyre *et al.* (41) report on use of ventromedial quadrant coagulation, a technique first recorded in 1950 and for which certain operative advantages over lobotomy are claimed. Of 30 patients, 26 were relieved of anxiety and 17 achieved maximal socioeconomic recovery after illnesses of four to ten years duration.

*Prognosis.*—Zubin & Windle (42) consider the generally variable and contradictory nature of prognostic indices which have been reported for various psychological tests and discuss the methodological problems which beset the search for prognostic factors. The need for careful specification and delineation of the clinical material is illustrated in their finding that complex reaction-time bore a significant but opposite relationship to improvement rates in chronic and acute patients respectively.



Pascal *et al.* (43 to 46) report a series of investigations into prognostic factors based on analysis of the case histories of 486 hospitalized mental patients. After initial determination of a set of 11 variables which discriminated between all improved and all unimproved patients, a process of progressive elimination of cases was applied to arrive at two subsamples of equal size for which there was no mean difference between the "improved" and "unimproved" groups on all but one of these 11 variables. The reliability of the difference between the two groups for this "independent" variable was then determined. So far, reports have appeared on the "isolated" influence of: type of onset, precipitating stress, duration of illness, and affective expression. For example, it was found that the omnipresent "duration of illness" factor no longer differentiated the two outcome groups when such variables as affective expression, direction of aggression, and type of onset were equated. There is a valuable lesson in these studies for those workers interested in the vital problem of prognosis. The findings would have been enhanced if multivariate analysis had been applied so that the complete data of the original sample could have been utilized and interactional effects among the equated variables taken into account. These are "short-term" studies inasmuch as status one year postdischarge was the criterion. It will be valuable to have later reports of parallel studies using a longer posthospital interval.

Two studies are reported on hospitalized female psychotics. Rose & Butler (47) studied two groups of women who were hospitalized between the ages of 16 to 20, a chronic group hospitalized over two years, and an acute group with less than two years hospitalization. Failure to control for diagnosis limits the meaningfulness of their analyses of social history data. It is interesting to note that the chronic group was characterized significantly by oral difficulties and aggressiveness although these items were nearly mutually exclusive within these patients. A simple unit-weighting of seven differentiating social-history items permitted an 80 per cent accurate separation of the two groups. No cross-validation is reported. Orr *et al.* (48) report on the relation of "treatability," age, length of hospitalization, education, vocational class, and family structure to discharge rates in 206 females. A six-step rating of treatability was based on responses to Cards I, III, and VIII, of the Rorschach; Binet vocabulary score; and an interview appraisal of personality assets. Length of stay was inversely related to discharge rates, while amount of education and number of close living relatives were positively related. There was no difference in discharge rates between those patients who received any form of therapy and those who had none!

Crandell *et al.* (49) report on an extension of the "occlusive index" developed in the Columbia-Greystone project to a study of prognosis in a general sample. An "immobility index" was computed for the first year, first two years, first three and four years of hospital residence of a sample of 858 patients for whom two-, five-, eight-, and thirteen-year follow-up data were

available. This index (the ratio of the total number of hospital days minus home visit days for visits of over two weeks' duration to the number of moves into the hospital including first admission) for the first two years of residence was found to bear a significant inverse relationship to outcome, with the duration of hospitalization accounting for most of the relationship.

Schofield *et al.* (50) report an exhaustive analysis of over 200 items derived from the medical, social, and psychiatric hospital records of schizophrenics who had been briefly hospitalized for diagnostic study during a period prior to utilization of ECT and insulin. Separation into "good" and "poor" outcome groups was based on evaluation of social recovery by a social worker who made direct, field contact with the patients an average of eight years following their discharge. Of the 17 items which differentiated the two outcome groups, the most discriminating were (in direction of good prognosis): poor school deportment, good marital adjustment, acute onset, absence of previous episodes, poor hospital adjustment, absence of ideas of reference, disorientation for time, and depression.

Hollingshead & Redlich (51) report a further study in their significant series on the relationship of social class to psychiatric disorder. In their census of mental patients in the greater New Haven (Connecticut) community, they found an incidence of schizophrenia in the lowest social class (V) which was nearly two-and-one-half times the proportionate representation of this class in the community population. The "index of prevalence" for class V was 11 times greater than that of the highest social class (I). To explain this disproportionate concentration of schizophrenia in Class V, the hypotheses that schizophrenics are more mobile both geographically and socially were submitted to separate test and rejected. When an "index of current prevalence" was computed, i.e., the relative number of patients from each class who were in treatment for various amounts of time from one year up to and including 21, class differences were again found which indicated that the prevalence in Class I and II patients dropped after two years of treatment while the index for Class V patients increased with successive years of treatment. This finding was interpreted to indicate that the different social classes do not have uniform response to the "treatment process." The significance of this was made more clear when the social classes were compared with respect to types of therapy received. Seventy per cent of Class V patients received organic therapy, while only nine per cent received individual psychotherapy; by contrast, Class I and II patients had a 17 per cent frequency of organic therapies and an 83 per cent rate for individual psychotherapy. One would be considerably more disturbed by the suggestion that differential psychiatric treatment is determined by class membership rather than clinical pathology if there were convincing evidence of a truly differential effectiveness of organic and psychological therapies.

In view of the very limited data on the subsequent histories of patients who attempt suicide and the generally grave import assigned to such acts, a

one-year follow-up study of 200 consecutive cases admitted for observation is of considerable interest. Batchelor & Napier (52) report on such a series which was composed of 112 depressive cases, 42 psychopaths, 12 epileptics, and 11 schizophrenics with nearly equal sex representation. Over half of the sample was detained less than a week, and 114 were discharged home. During the year following admission, three of these patients committed suicide (possibly a fourth), and seven made further attempts. By contrast, Farberow & Schneidman (53) report on a sample of 96 male, veteran, suicidal patients classified as "attempt," "threat," and "completed" groups. Of the completed group ( $N=32$ ), average hospitalization was three and a half months, 84 per cent had been previously hospitalized, 62 per cent had made previous attempts, 69 per cent had committed suicide within one year, and 41 per cent within three months following discharge.

#### THE NEUROSES

During the period covered by this review it appears that research studies of the neuroses have been much fewer than investigations of the psychoses, with most attention being paid to problems of diagnosis and etiology. However, it should be noted that studies of psychotherapy are reported in a separate chapter.

Gough (54) utilized an item analysis of MMPI responses to demonstrate that normals have erroneous ideas of what characterizes the typical test behavior of diagnosed neurotics. He developed a scale for identification of faked neurosis.

Doust (55) prepared a 99-item questionnaire covering attitudes and behaviors suggested by the literature and clinicians to reflect emotional immaturity. Scores on this scale and on 18 subscales were studied for their differentiating power with respect to controls and six psychiatric groups. Correlation of an immaturity index with age was found to be  $-.29$  in the normals; this general index showed diagnostic promise, but the profile on subscales is of questionable value since 13 of the 18 scales are composed of six or fewer items.

Whitman, Trosman & Koenig (56) investigated a sample of 400 outpatients with respect to the relationship of clinical reaction types to diagnoses of passive-aggressive personality. It is not surprising that they found considerable clinical confusion in the understanding of this poorly defined category of "arm chair" origin; it seems unlikely that their largely "arm chair" suggestion for revision will add much clarification.

Levine *et al.* (57) report the use of the autokinetic phenomenon to measure the effect of group influence on neurotic judgments. A small sample of neurotics showed greater variability of response and less susceptibility to group influence than nonneurotics.

Osgood & Luria (58) applied the semantic-differential technique in a blind analysis of the multiple personality excellently reported by Thigpen

& Cleckley (59). Since both accounts are largely descriptive, although in different terms, a degree of validation can be attempted in reading the respective summary accounts of the various personalities. Such comparison suggests that the semantic differential has achieved a degree of economy and precision in delineating the personality structures suggested by the clinical data. Osgood & Luria make specific "predictions" permitting of validation, e.g., that "Jane" was the "original" personality, although the difficulty of proof as to which of the three "persons" is the real one becomes increasingly apparent with re-reading of the case report.

Watson *et al.* (60), noting the central place occupied by hostility in psychoanalytic theory of neurosis, tested the hypothesis that under conditions permitting release of repression, neurotics would reveal greater hostility than normals. Forty-five patients and 45 controls were administered a scrambled-sentence-completion test in which selective dropping of a single word resulted in a sentence having either hostile or neutral content. Under circumstances calling for rapid response, the neurotics did show a reliably greater frequency of hostile completions. Analysis by content revealed the sentences which most clearly differentiated the two groups in terms of neurotic hostility to be those involving personal aggression. The sentences revealing greater hostility of controls tended to express impersonal or object-oriented aggression.

Watson & Comrey (61) describe "nutritional replacement" as a therapy for "emotionally disturbed" subjects. Thirty-four volunteer ambulatory subjects with MMPI records having at least one "elevated" (?) score were randomly assigned to placebo and experimental groups. The latter group took daily oral dosages of capsules and tablets containing some 50 nutritional substances including vitamins, mixed fatty acids, wheat germ, alfalfa, kelp, and watercress. Subjects were retested once a month on the MMPI with reduction in total scale score used as a measure of improvement, in addition to clinical evaluation. The authors conclude that there was a significant rate of improvement in the treated group. It is not clear whether psychotherapy was given in addition to or as a side-benefit of the dietary manipulation, and the degree to which experimental controls prohibited differential suggestive effects is uncertain. The authors' conclusion that their study demonstrates the effect of "purely physical" therapy seems unjustified in light of the many uncontrolled variables, not the least of which were the attitudes of the personal physicians of their subjects.

Moriarty (62) gives a positive evaluation of CO<sub>2</sub> inhalation based on experience with 100 patients representing diverse but largely neurotic diagnoses. Forty-two per cent of these were considered "much improved" and an additional 39 per cent "improved."

Using a control group, Hargrove *et al.* (63) report on experience with 100 neurotics having primary symptoms of anxiety and depression. Of these, 50 patients received psychotherapy exclusively, and 50 had CO<sub>2</sub> inhalation

combined with psychotherapy. Of the former, 75 per cent showed improvement or social recovery in contrast to only a one-third improvement rate in the latter. The authors conclude that CO<sub>2</sub> added seriously to problems of transference and resistance.

In the only significant prognostic study, Peterson (64) examined various indices empirically derived to discriminate between samples of veteran outpatients who were and were not subsequently hospitalized. Clinical behavior manifesting psychosis was absent from both samples, but it was found that the patients subsequently hospitalized were characterized by outpatient MMPI profiles which were of psychotic type. An index combining four non-psychometric signs, four MMPI signs, and a sign from the Wechsler-Bellevue Scale, yielded accurate classification of 75 per cent of the two groups.

#### BEHAVIOR DISORDERS

Sex offenders have been investigated through statistical, physiological, and psychodynamic approaches. Atcheson & Williams (65) report a descriptive study of 116 boy and 167 girl sex offenders, the total contacted by the Juvenile Court Clinic of Toronto (Ontario) between 1939 and 1948, using a control group of nonsex offenders randomly selected to equal the number of sex offenders year by year. The sex offender, in profile, was found to be more frequently female, older than the nonsex offender but equal in IQ, and less often a recidivist than the control. Females more frequently are charged vaguely with promiscuity, while males are charged with specific sex deviations. Mental defectives were twice as frequent among the male sex offenders as among their controls. The incidence of serious psychiatric disturbance among the male sex offenders was six times that among their controls.

Ellis *et al.* (66) made a comprehensive statistical analysis of 37 variables recorded for the first 200 sex offenders sent to a diagnostic center in accordance with the New Jersey Sex Offender Act of 1949. It may be inferred that this sample is exclusively male, although sex is not specifically stated. The intercorrelations among all variables are reported together with a summary of significant relationships. Patterns of significant differentiation were observed between Negroes versus whites, those with extenuating circumstances to their offense versus those without, and those with deviational versus nondeviational offenses.

An exploratory study aimed at differentiating subgroups of hospitalized male sex offenders is reported by Marsh *et al.* (67). This group found that clinically separated "major" and "minor" offenders were differentiated with respect to the level and variability of rennin inhibitor level in the blood, a function which has been suggested to reflect maturity.

Glueck (68) evaluated over 200 sex offenders imprisoned at Sing Sing with respect to the presence or absence of the 16 diagnostic characteristics which Cleckley (69) attributes to the psychopath. Although a majority of

Glueck's subjects were diagnosed as psychopathic personalities, Glueck found only five of Cleckley's traits to be present in significant frequency.

The final report of the California State research program (70) on sexual deviation is valuable for its synopses of sexual psychopath laws in the United States and its analysis of 73 girl victims of adult sex offenders. It is of interest that over half of these girls were classified as "participating" rather than "accidental" victims.

A major publication is Karpman's (71) comprehensive volume on sexual offenses. This provides an excellent reference work in which nomenclature, law, research studies, theories, and therapies are presented in well organized, lucid chapters, each with succinct summaries. Case illustrations are profuse and generally well selected except for occasional extensions bordering on the pornographic.

A very interesting paper by Shupe (72) reports the urine alcohol concentration found in 882 persons arrested during or immediately after the commission of a felony. These persons were arrested and tested by the crime detection laboratory of the Columbus (Ohio) Police Department between March, 1951 and March, 1953. No discrimination was made between the chronic alcoholic and the impulsive drinker. Twelve different crimes are listed with the frequency of various levels of alcohol concentration found in the criminals involved, from nil to .40 per cent and over. A level of .10 per cent urine alcohol is considered the dividing line between sobriety and intoxication. Approximately two-thirds of all crimes were committed under the influence of alcohol. But only half of the rapes and felonious assaults were perpetrated under states of intoxication. The highest rates of associated intoxication (80 per cent and over) were found for "cutting, other assaults, carrying a concealed weapon, and shooting." Shupe cautions that his data bear only on persons apprehended and do not permit direct inference as to the general association between criminal behavior and use of alcohol.

Dunham (73) analyzed the distributions of some 74 measures as found in white, American-born, adult male prisoners who were respectively recidivists and nonrecidivists at the time of their admission to San Quentin in 1946. The variables studied included personal-history items, education, school achievement, verbal and performance measures of intelligence, special aptitudes, and personality measures. Since approximately four items would be expected by chance to meet the .05 level of significance, the finding of only five variables which are distinguishable at this level suggests that postprison outcome, like outcome in psychiatric disorders, may be heavily determined by subtle and chance factors of the individual's environment which are difficult to capture in the statistical net. The factors related to recidivism included elevation on the D and Pd scales of the MMPI, lower Wechsler-Bellevue digit span (mean difference in raw score of .5!), and punishment record for one year. These measures give excellent illustration of the practical "fallaciousness" of statistically "significant" differences when critical

ratios are based on large samples. No combination of these factors would generate an improvement over chance in individual prediction.

Taterka & Katz (74) studied the relationship between EEG findings, psychological test data, and symptomatology in 195 schizophrenics and primary behavior disorder cases in the five-and-a-half to twelve-and-a-half age range, and in 44 controls matched for age and sex but without emotional disturbance. Abnormal EEGs were obtained in 78.6 and 73.4 per cent respectively of the schizophrenics and behavior disorder cases. No relationship was found between EEG pathology and any specific behavior deviation such as passivity or hyperactivity. EEG foci in the occipital region were related to gross distortions in Bender-Gestalt performance, figure drawing, and form accuracy on the Rorschach.

Three books are concerned with juvenile delinquency. Vedder (75) presents a collection of selected readings which are grouped by major topics (e.g., economic conditions and familial factors, juvenile courts, probation, etc.), each introduced by orientational remarks and brief annotation. The readings are largely journalistic rather than scientific, and exhortation seems to outweigh evidence. Barron (76) presents a thoughtful, documented review of the extent, etiology, and management of delinquency. The title of this work suggests that the author will show a preference for sociologic dynamics over constitutional or psychological causation, but in actuality he makes a fair presentation of both sides of the "made" versus "born" controversy. Landner (77) makes a distinctive contribution to research in an analysis of the relationship of the common indices of socioeconomic status to over 8,000 cases of juvenile delinquency in Baltimore. Introducing techniques of partial and multiple correlation analysis, factor analysis, and correction for curvilinear relationships, he demonstrates the "net" effects on delinquency rates of such factors as substandard housing, Negro-white proportion, and educational levels. He concludes:

The delinquency rate is fundamentally related only to the *anomie* and not specifically to the socio-economic conditions of an area. The delinquency rate in a *stable* community will be low in spite of its being characterized by bad housing, poverty, and propinquity to the city center.

#### PSYCHOSOMATIC DISORDER

A careful experimental investigation of the hypothesis that patients with essential hypertension have characteristic patterns of aggressiveness is described by Matarazzo (78). While the hypertensive and normotensive subjects were not differentiated by a variety of psychological test variables having inferential relationship to "aggressivity," they were reliably differentiated by their relative frequencies of overt aggression, i.e., refusal to carry out experimental tasks.

Blumberg *et al.* (79) report a fascinating and suggestive study of the relationship of personality variables of defensiveness, depression, and anergic



attitude to the rapidity of progression of cancer. Three very simple, objective indices derived from the MMPI profile permitted identification of all but three of 25 "fast" cases and all but eight of 25 "slow" cases equated for age, intelligence, socioeconomic status, religion, and nationality. All cases were tested during periods of remission so that reaction to symptomatology directly would not determine differences in affect or morale. The authors suggest that rate of cancer growth may be increased by the presence of independent, chronic, emotional stress.

Hall & Stride (80) used a controlled heat stimulus to study pain perception and pain tolerance in 400 psychiatric subjects of both sexes between the ages of 18 to 70, noting a very high level of pain tolerance in depressed patients and a decrease in tolerance level of patients making a favorable clinical response to ECT. And a fourth edition of Dunbar's (81) classical reference work has appeared, summarizing the psychosomatic literature from 1910 to 1953.

#### GENERAL WORKS

Taylor (82) has written a text which is difficult to classify since neither content nor organization places it clearly in the clinical, abnormal, or personality areas. It presents a scholarly review of the general principles of human psychology in a motivational framework with description-explanation of pathology as a consistent goal and should prove useful in a variety of contexts. It is particularly rich in well selected examples of pathology.

Knight (83) has edited a collection of clinical and theoretical papers by the staff of the Austen Riggs Center (Stockbridge, Massachusetts). His own review of the history and current status of psychoanalysis in the United States is valuable on many counts, not the least of which is its very frank reference to the "splinter" movements and sibling rivalries of recent years.

Stimulated by observation of the "initiation rites" of neurotic and psychotic children, Bettelheim (84) undertakes a critical review of psychoanalytic and anthropological theories. He is delightfully free of the all too ubiquitous need to "prove again" the genius of the "master" and is equally free from the need to impose closure where data simply will not support it. Bettelheim is content to raise some engaging new hypotheses as to the origins of castration rituals.

Rosen (85) has edited a broad review of the problem of therapeutic abortion. This collection of papers is notable for the concise, nonoverlapping treatments which the various authors have given to their respective topics.

A small volume by Moses (86) presents the undocumented thesis that "the majority of neuroses has an almost characteristic vocal expression"; a detailed and well described system for vocal analysis is accompanied by a rather vague auditory phrenology.

A socioeconomic and psychological analysis of suicide and homicide is presented by Henry & Short (87). Study of the relative rates of these two

acts in various social groups and at various phases of the business cycle leads to an hypothesis combining the frustration-aggression principle with a concept of external restraint to aggression as a dual function of social status and strength of interpersonal relationships. These latter variables permit of a disarmingly objective specification in terms of levels or degrees for which the associated psychological forces may be obscured. However, these authors present extensive and challenging data in support of their theory.

Rose (88) has edited a general reference work on the sociology of mental health. The section on social characteristics of the mentally disordered is particularly valuable.

The always intriguing subject of hypnotism, its mechanics, phenomena, and theory, is brought up-to-date in an exhaustive, objective review by Weitzenhoffer (89). And, finally, students of psychopathology will welcome the appearance of the first English translation of Schreber's famous *Memoirs* (90), the material on which Freud founded his theory of paranoia.

#### SUMMARY AND OVERVIEW

Theory of psychopathology is diffuse and far from unified. There is strong conviction that psychosis and neurosis have their origin in man's history and equally strong conviction that they arise from man's heredity, with workers generally engaged in projects or polemics to prove one of these hypotheses rather than to test both. Therapies are for the most part empirical, having just that modicum of rationale necessary to dignify endeavors which range from tender, loving care to cooking of the brain. The only uniform prognostic finding is that recovery rates are inversely related to duration of pathology. For all the voluminous and expanding literature, it remains true and challenging that for the so-called functional or so-called non-organic behavior disorders, etiology is unknown, and treatment and prognosis uncertain.

Workers who look within the home and workers who look within the head are equally able to define phenomena for which an etiologic role is strongly suggested. The absence of adequate controls (observational, experimental, and statistical) generally prohibits representatives of either approach from introducing their conclusions with that phrase basic to all scientific formulations, *ceteris paribus*. In fact, rather rarely do the proponents of these disparate philosophies reveal any awareness of the importance of this restriction! Comparably, those who have aimed at treating rather than explaining are rather uncritical of the fact that their respective procedures (chemical, electrical, or surgical) achieve approximately equal outcomes, *ceteris paribus*! That this is so suggests the possibility that nonspecific therapies are all initially and equally contaminated by a psychological factor of conviction and enthusiasm on the part of their investigators. We do not yet have adequately derived indices of prognosis, relative to criteria of spontaneous remission versus chronicity, which would permit a selection of

control and experimental subjects to make critical test of the therapeutic contribution of any specific procedure.

There are encouraging trends. The problem of achieving more exact description and delimitation of clinical groups is being profitably pursued by use of multiple, objective rating scales and factor analytic techniques. Examination of both etiologic and prognostic factors by techniques of multivariate analysis promises a sounder basis for more precise and testable hypotheses in these realms. Greater precision in techniques of interference with brain structure and function also permits clarification of hypotheses. It is to be hoped that misplaced confidence in what we think we already know will not retard a full and energetic attack with these new and better methodologies.

#### LITERATURE CITED

1. Heath, R. G., *Studies in Schizophrenia: A Multidisciplinary Approach to Mind-Brain Relationships* (Harvard University Press, Cambridge, Mass., 619 pp., 1954)
2. King, H. E., *Psychomotor Aspects of Mental Disease: An Experimental Study* (Harvard University Press, Cambridge, Mass., 185 pp., 1954)
3. Malamud, W., and Sands, S. L., *Am. J. Psychiat.*, **104**, 231-37 (1947)
4. Beck, S. J., *The Six Schizophrenias: Reaction Patterns in Children and Adults* (Research Monograph No. 6, American Orthopsychiatric Association, New York, N. Y., 238 pp., 1954)
5. McAuley, W. F., *The Concept of Schizophrenia* (Philosophical Library, New York, N. Y., 145 pp., 1954)
6. Malzberg, B., *Psychiat. Quart.*, **28**, 312-19 (1954)
7. Malzberg, B., *Psychiat. Quart.*, **28**, 398-409 (1954)
8. Roberts, B. H., and Myers, J. K., *Am. J. Psychiat.*, **110**, 759-64 (1954)
9. Benedict, P. K., and Jacks, I., *Psychiatry*, **17**, 83-93 (1954)
10. Peters, H. N., and Murphree, O. D., *J. Clin. Psychol.*, **10**, 126-30 (1954)
11. Michaux, W., *J. Abnormal Social Psychol.*, **50**, 53-58 (1955)
12. Wertheimer, M., *J. Gen. Psychol.*, **51**, 291-99 (1954)
13. Epstein, S., *J. Abnormal Social Psychol.*, **50**, 65-70 (1955)
14. Jenkins, R. L., *Arch. Neurol. Psychiat.*, **73**, 110-17 (1955)
15. Freeman, R. V., and Grayson, H. M., *J. Abnormal Social Psychol.*, **50**, 45-52 (1955)
16. Whiteman, M., *J. Abnormal Social Psychol.*, **49**, 266-71 (1954)
17. Peterson, D. R., *J. Consulting Psychol.*, **18**, 198-200 (1954)
18. Ellingson, R. J., *Am. J. Psychiat.*, **111**, 263-75 (1954)
19. Brockway, A. L., Gleser, G., Winokur, G., and Ulett, G. A., *Am. J. Psychiat.*, **111**, 248-62 (1954)
20. Jenkins, R. L., and Lorr, M., *J. Clin. Psychol.*, **10**, 114-19 (1954)
21. Wittenborn, J. R., *J. Consulting Psychol.*, **15**, 290-302 (1951)
22. Lorr, M., Jenkins, R. L., and O'Connor, J. P., *J. Abnormal Social Psychol.*, **50**, 78-86 (1955)
23. Irvine, R. P., *J. Abnormal Social Psychol.*, **49**, 87-88 (1954)
24. Peters, H. N., and Jenkins, R. L., *Psychiat. Quart.*, **28**, Suppl., 1-17 (1954)

25. Kamman, G. R., Lucero, R. J., Meyer, B. T., and Rechtschaffen, A., *Psychiat. Quart.*, **28**, 650-67 (1954)
26. David, H. P., *Am. J. Psychiat.*, **110**, 774-76 (1954)
27. Lifschutz, J. E., *Am. J. Psychiat.*, **111**, 466-67 (1954)
28. Brannon, E. P., and Graham, W. L., *Am. J. Psychiat.*, **111**, 659-63 (1955)
29. Coleman, J. C., and Hellman, L. I., *J. Psychol.*, **37**, 243-49 (1954)
30. Wells, F. L., and Ruesch, J., *Mental Examiners' Handbook* (Psychological Corporation, New York, N. Y., 211 pp., 1945)
31. Bond, E. A., *Am. J. Psychiat.*, **110**, 561-66, 881-87 (1954)
32. Freyhan, F. A., *Am. J. Psychiat.*, **111**, 22-32 (1954)
33. Jackson, C. L., and Jaco, E. G., *Am. J. Psychiat.*, **111**, 353-57 (1954)
34. Jenkins, R. L., Holsopple, J. Q., and Lorr, M., *Am. J. Psychiat.*, **111**, 84-90 (1954)
35. Lorr, M., Holsopple, J. Q., Jenkins, R. L., and O'Connor, J. P., *J. Consulting Psychol.*, **19**, 39-43 (1955)
36. Medina, R. F., Pearson, J. S., and Buchstein, H. F., *J. Nervous Mental Disease*, **119**, 23-30 (1954)
37. Mettler, F. A., Crandell, A., Wittenborn, J. R., Litten, K., Feiring, E. H., and Carpenter, M. B., *Psychiat. Quart.*, **28**, 549-606 (1954)
38. Landis, C. and Hamwi, V., *Psychiat. Quart.*, **28**, Suppl., 78-83 (1954)
39. Lindstrom, P. A., *Ultraschall Med. u. Grenzgebiete*, **7**, 85-93 (1954)
40. Lindstrom, P. A., *Arch. Neurol. Psychiat.*, **72**, 399-425 (1954)
41. McIntyre, H. D., Mayfield, F. H., and McIntyre, A. P., *Am. J. Psychiat.*, **111**, 112-19 (1954)
42. Zubin, J., and Windle, C., *J. Abnormal Social Psychol.*, **49**, 272-81 (1954)
43. Bayard, J., and Pascal, G. R., *J. Consulting Psychol.*, **18**, 122-26 (1954)
44. Swensen, C. H., Jr., and Pascal, G. R., *J. Consulting Psychol.*, **18**, 127-30 (1954)
45. Cole, M. E., Swensen, C. H., and Pascal, G. R., *J. Consulting Psychol.*, **18**, 171-75 (1954)
46. Swensen, C. H., Jr., and Pascal, G. R., *J. Consulting Psychol.*, **18**, 363-65 (1954)
47. Rose, D. M., and Butler, M. C., *Psychiat. Quart.*, **28**, Suppl., 1-19 (1954)
48. Orr, W. F., Anderson, R. B., Martin, M. P., and Philpot, D. F., *Am. J. Psychiat.*, **111**, 576-82 (1955)
49. Crandell, A., Zubin, J., Mettler, F. A., and Logan, N. D., *Psychiat. Quart.*, **28**, 185-210 (1954)
50. Schofield, W., Hathaway, S. R., Hastings, D. W., and Bell, D. M., *J. Consulting Psychol.*, **18**, 155-66 (1954)
51. Hollingshead, A. B., and Redlich, F. C., *Am. Sociol. Rev.*, **19**, 302-6 (1954)
52. Batchelor, J. R. C., and Napier, M., *J. Neurol. Neurosurg. Psychiat.*, **17**, 261-66 (1954)
53. Farberow, N. L., and Schneidman, E. S., *J. Abnormal Social Psychol.*, **50**, 230 (1955)
54. Gough, H. G., *J. Consulting Psychol.*, **18**, 287-92 (1954)
55. Doust, J. W. L., *Am. J. Psychiat.*, **110**, 651-63 (1954)
56. Whitman, R. M., Trosman, H., and Koenig, R., *Arch. Neurol. Psychiat.*, **72**, 540-49 (1954)
57. Levine, J., Laffal, J., Berkowitz, M., and Drevdahl, J., *J. Abnormal Social Psychol.*, **49**, 251-55 (1954)

58. Osgood, C. E., and Luria, Z., *J. Abnormal Social Psychol.*, **49**, 579-91 (1954)
59. Thigpen, C. H., and Cleckley, H., *J. Abnormal Social Psychol.*, **49**, 135-51 (1954)
60. Watson, R. E., Pritzger, L., and Madison, P., *J. Abnormal Social Psychol.*, **50**, 36-40 (1955)
61. Watson, G., and Comrey, A. L., *J. Psychol.*, **38**, 251-64 (1954)
62. Moriarty, J. D., *Am. J. Psychiat.*, **110**, 765-69 (1954)
63. Hargrove, E. A., Bennett, A. E., and Steele, M., *Am. J. Psychiat.*, **110**, 844-49 (1954)
64. Peterson, D. R., *J. Abnormal Social Psychol.*, **49**, 260-65 (1954)
65. Atcheson, J. D., and Williams, D. C., *Am. J. Psychiat.*, **111**, 366-70 (1954)
66. Ellis, A., Doorbar, R. R., and Johnston, R., *J. Social Psychol.*, **40**, 3-15 (1954)
67. Marsh, J. T., Hilliard, J., and Liechti, R., *Arch. Neurol. Psychiat.*, **72**, 341-47 (1954)
68. Glueck, B. C., Jr., *Psychiat. Quart.*, **28**, 1-21 (1954)
69. Cleckley, H., *The Mask of Sanity* (C. V. Mosby Co., St. Louis, Mo., 569 pp., 1950)
70. Rapaport, W., *Final Report on California Sexual Deviation Research*, **20**, No. 1 (Department of Mental Hygiene, State of California, 160 pp., 1954)
71. Karpman, B., *The Sexual Offender and His Offenses. Etiology, Pathology, Psychopathology, and Treatment* (Julian Press, Inc., New York, N. Y., 746 pp., 1954)
72. Shupe, L. M., *J. Criminal Law, Criminol. Police Sci.*, **44**, 661-64 (1954)
73. Dunham, R. E., *J. Social Psychol.*, **39**, 77-91 (1954)
74. Taterka, J. D., and Katz, J., *Psychosomat. Med.*, **17**, 62-72 (1955)
75. Vedder, C. B., *The Juvenile Offender. Perspective and Readings* (Doubleday & Co., Inc., Garden City, N. Y., 510 pp., 1954)
76. Barron, M. L., *The Juvenile in Delinquent Society* (Alfred A. Knopf, Inc., New York, N. Y., 349 pp., 1954)
77. Landner, B., *Towards an Understanding of Juvenile Delinquency. A Study of 8,464 Cases of Juvenile Delinquency in Baltimore* (Columbia University Press, New York, N. Y., 143 pp., 1954)
78. Matarazzo, J. D., *J. Personality*, **22**, 423-47 (1954)
79. Blumberg, E. M., West, P. M., and Ellis, F. W., *Psychosomat. Med.*, **16**, 277-86 (1954)
80. Hall, K. R. L., and Stride, E., *Brit. J. Med. Psychol.*, **27**, 48-60 (1954)
81. Dunbar, F., *Emotions and Bodily Changes*, 4th ed. (Columbia University Press, New York, N. Y., 1192 pp., 1954)
82. Taylor, W. S., *Dynamic and Abnormal Psychology* (American Book Co., New York, N. Y., 658 pp., 1954)
83. Knight, R. P., Ed., *Psychoanalytic Psychiatry and Psychology*, **I** (International Universities Press, Inc., New York, N. Y., 391 pp., 1954)
84. Bettelheim, B., *Symbolic Wounds. Puberty Rites and the Envious Male* (The Free Press, Glencoe, Ill., 286 pp., 1954)
85. Rosen, H., Ed., *Therapeutic Abortion. Medical, Psychiatric, Legal, Anthropological and Religious Considerations* (The Julian Press, New York, N. Y., 348 pp., 1954)
86. Moses, P. J., *The Voice of Neurosis* (Grune & Stratton, New York, N. Y., 131 pp., 1954)

87. Henry, A. F., and Short, J. P., Jr., *Suicide and Homicide. Some Economic, Sociological and Psychological Aspects of Aggression* (The Free Press, Glencoe, Ill., 214 pp., 1954)
88. Rose, A. M., *Mental Health and Mental Disorder. A Sociological Approach* (W. W. Norton & Co., Inc., New York, N. Y., 626 pp., 1955)
89. Weitzenhoffer, A. M., *Hypnotism. An Objective Study in Suggestibility* (John Wiley & Sons, Inc., New York, N. Y., 380 pp., 1953)
90. Macalpine, I., and Hunter, R. A., Trans. and Eds., *Daniel Paul Schreber, Memoirs of My Nervous Illness* (William Dawson and Sons, Ltd., London, England, 416 pp., 1955)

## CLINICAL METHODS: PSYCHOTHERAPY<sup>1,2</sup>

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First a note for the general reader: of the year's output three books may be read with pleasure and profit. Sullivan has written a book of an almost "how to do it" character in *The Psychiatric Interview* (102). Coming close after his theoretical *Interpersonal Theory of Psychiatry* (101), it affords glimpses of how Sullivan interacted with patients and his reasons for doing what he did in a particular situation. In contrast with his earlier works, which suffered from obscurity of expression, the incisive description of rationale and method in the present volume allows one to see why Sullivan has become one of the most potent forces shaping contemporary psychotherapeutic thinking and methods of training. He accepted the role of the therapist as an expert in human relations, a role which patients attribute to the therapist and which Sullivan felt should be merited by virtue of training and interests. The more active role to which he holds contrasts sharply with the more passive role assigned the therapist by other schools of thought. One gets a clear picture of Sullivan and a patient working together on a mutually-agreed-to enterprise, that of identifying and correcting the difficulties the patient experiences in conducting his relations with other people. The principles Sullivan treats are not limited to therapeutic interviewing; they will be helpful in other kinds of interviewing and personal interactions.

The second rewarding experience the reader may find is in reading Braatoy's *Fundamentals of Psychoanalytic Technique* (16). Braatoy was a Norwegian psychiatrist, actually a cosmopolitan, of remarkably broad education and experience, unstereotyped and with an acute ear for the off-beat. His book draws on many fields of learning, including the basic sciences, literature, and experimental psychology, but he remains close to clinical data. He is at his best in describing the range of cues he responds to in a patient's behavior and the perspective from which he guesses their meaning. His comments on Murray's account of his own analysis (63) illustrate something of therapeutic process:

In listening to Henry A. Murray . . . I crave the same right as in listening to music: a good chair. . . . Listening to the Second Symphony by Murray, I would probably from time to time feel, sense, or hear a sequence of expressions repeating themselves in a certain way—like a theme in the cellos not as yet dominating the total orchestra. I might permit myself to comment on these half-expressed themes before I understood what they were about or meant, because such comments are

<sup>1</sup> The survey of the literature to which this review pertains was completed in May, 1955. The writer wishes to acknowledge the help of Dr. Betty L. Kalis in preparing the manuscript, especially the section on group psychotherapy.

<sup>2</sup> The following abbreviations are used in this chapter: MMPI (Minnesota Multiphasic Personality Inventory); TAT (Thematic Apperception Test).



hints to the analysand that the listener also is interested in tensions not as yet fully accepted by the analysand. I might even permit myself to express these comments in vague, unfocused ways if that would convey my interest and at the same time show that I did not intend to compete with the analysand in clarity.

This would be the first phase of such an analysis, a phase Murray experienced like an intellectual-emotional orgy with Jung. Out of this basic gratification, the analysand might achieve the right, the confidence to express aggression in connection with comments disclosing that the analyst had not caught a point. If the analyst thus succeeds in thawing out of the compensated, highly sophisticated intellectual more direct, less sophisticated expressions, he has obtained the emotional cooperation which one day permits him to say: "I wonder whether some times when you are most scintillating, more sophisticated than the Philosophical Faculty at Harvard and the *New Yorker* rolled into one, you are circumventing some direct expressions of very simple needs." This question will not ring a bell in the child inside the analysand before the analyst has demonstrated his interest in the analysand as he is today.

The third item which will interest the general reader is the Rogers & Dymond report (76) of a major research effort on client-centered therapy. It will be reviewed in detail below.

For readers with more specialized interests, a word about the scope of this review. The psychiatric, social work, and psychological periodicals and books were scanned with two criteria in mind: If I were engaged in the practice of psychotherapy, or (something quite different) if I were doing research on psychotherapy, is this something I would have to take account of? Such criteria are arbitrary, time-bound, and limited by the perspective of the reviewer, and some important contributions may have been overlooked. Much of the writing encountered was redundant and noisy, as the communications experts use those terms. Many oddities were uncovered, and some gems of scholarship, for example Stone's paper "On the principal obscene word in the English language (an inquiry with hypothesis regarding its origin and persistence)" (97). The criterion served to eliminate papers purporting to delineate something about the nature of psychotherapy but which actually were more relevant to personality and psychopathology as seen from the vantage point of the temporally extended period required for serious therapeutic effort. Some areas were excluded: professional problems; child therapy, with a few exceptions; and the effects of drugs used as adjuncts.

#### PREDICTION, COURSE, AND OUTCOME OF INDIVIDUAL PSYCHOTHERAPY

In prediction studies an initial state may be specified by indices chosen because they seem likely to predict a criterion of outcome, although the indices themselves are not expected to change through therapy; examples would be scores on the Wechsler-Bellevue or socioeconomic status. Or variables may be chosen because they are relevant to the kinds of changes therapy may be expected to produce: the kind of complaint the patient presents, measures of the self-concept, personality test scores, etc. Repeated measures of such variables may yield information relevant to the process of therapy, particularly when the selection of variables is determined by a consistent theory of personality, how it changes, and what conditions in therapy may accelerate the change.

Attention has been paid to the variables specifying final state, the criteria of outcome, and complex measures have been suggested. For example, Miller (61) suggests, somewhat optimistically, that seven evidences of success relevant to psychoanalytic theory are potentially testable objectively: (a) important memories, attitudes, and feelings which before therapy were unconscious (unavailable to awareness and unreportable) become conscious and can be verbalized after therapy; (b) the resolution of conflicts; (c) flexibility of adjustment mechanisms; (d) suitability of the mechanisms of ego defense; (e) effective handling of anxiety; (f) working through of the Oedipus situation; and (g) resolution of transference.

Parloff, Kelman & Frank (70) describe three measures they are currently using to evaluate outcome and to compare different kinds of treatment. Comfort is measured with a checklist of symptoms taken from the Cornell Index, cast into rating scales, and with special scales written to describe interpersonal functioning. Ratings are obtained from the patient and, the authors ask reasonably enough, "Who else but the patient can report on his comfort?" (How about his wife?) Effectiveness in daily functioning is measured on rating scales describing the active and passive aspects of seven "modes of social operations," e.g., overindependent and overdependent, officious, and irresponsible. The scales are rated after interviewing the patient and a relative about his functioning in several areas: his own family, marital family, occupation, social activities, and the interviewer. Self-awareness is measured by agreement between an observer's impressions and the patient's description of his own behavior during an interview. Thirteen adjectives are rated on four-point scales from "not like I behaved" to "very much like I behaved." This last method seems to have excellent possibilities, but one would like to see more complex self-descriptions and measures less affected by purely evaluative judgments. As for the agreement between observer and patient, Cronbach (21) has demonstrated sources of error in methods purporting to measure one's understanding of another person. While operationally elegant, such methods have ambiguous substantive meaning.

*The prediction of outcome.*—In practice, investigators have been content with less complex criteria, and several studies have utilized duration of stay in therapy as a criterion against which to validate predictive indices. Gibby *et al.* (39) found that low scores on Rorschach R, K, and m identified neurotic patients whose therapy terminated within six months and who had fewer than 19 interviews. Rorschach R and Wechsler-Bellevue IQ yielded a multiple correlation of .50 with remaining in therapy. Social-class membership also predicted the criterion; more early terminators were from the lower socioeconomic levels. Therapists who were rated as "warm" and those who were more competent at "analytically oriented therapy" tended to keep unproductive patients in therapy. There were some differences related to the sex of the therapist (women were better); none among professions (psychiatrists, psychologists, social workers). The authors conclude: (a) patients who remained in therapy were, in general, more intelligent and more productive; (b) they appeared to possess the ambition and drive associated with the middle-class and upwardly mobile lower-class person in American so-

ciety; and (c) they showed a greater awareness of the psychological factors presumably responsible for their problems, and although they experienced anxiety, they were not incapacitated by it.

Winder & Hersko (111) confirm the association of socioeconomic status and duration of therapy. Robinson, Redlich & Myers (75) show that psychoanalytic treatment is usually limited to persons in professional and the higher managerial positions and that any kind of psychotherapy is rarely available to persons below the white-collar and skilled-labor levels.

A report by Redlich, Hollingshead & Bellis (74) adds some meaning to these findings. Thirteen neurotic patients were selected from Social Class III (proprietors, white-collar, and skilled manual workers) and 12 from Class V (unskilled and semiskilled workers with elementary education or less). Interviews were held with the patient, his family, and his psychotherapist. In comparison with Class III, Class V patients had more somatic complaints at the time of referral, they were less well informed about psychiatric procedures, their attitudes changed little during the course of therapy, and they communicated less well with the therapist. This last rating was based in part on the patients' inability "to understand the intent of the therapist"; many patients did not accept "the notion that psychological conflict may reveal itself in physical symptoms." This is a curious, one-way definition of communication and leads one to inquire whose communication skills were at fault, the patients' or therapists'. The difficulties in treating these patients (from both social classes) are reflected in the therapists' attitudes; only half of the therapists were judged by the interviewers as "liking" their patients. It should be pointed out that the therapists were relatively inexperienced and that most of the patients had been referred, either by physicians or by social agencies. Patients presenting themselves voluntarily for psychiatric treatment probably show different kinds of initial resistances. The authors point to the need for developing different techniques for treating patients from the lower socioeconomic levels. More broadly, this might be stated as a need to explore methods of handling various kinds of resistance, including lack of verbal skillfulness in patients, and their conviction that somatic disorders have a physical basis.

Duration of therapy recommends itself as an objective index, but its meaning is ambiguous. Obviously psychotherapy cannot be effective unless a patient is exposed to it, and Myers & Auld (64) have demonstrated that early termination in a community clinic is associated with a therapist's rating of "unimproved." However, long-continuing therapy may or may not be effective. The kind of person who becomes a psychotherapist is likely to set up an on-going, perhaps interminable, relationship with someone who is bright, verbally fluent, with values similar to his own, and who presents (to the therapist) complicated and interesting problems. But one cannot discount the effects of very brief therapy, sometimes fewer than 20 interviews. Occasionally people handle their problems differently simply because they realize they are so miserable and ineffective that referral to a therapeutic facility is necessary, or because they are referred at someone else's insistence.

Many child-guidance clinics see families for fewer than 20 interviews, and most of them can point to decisive effects they think they have had on a family's interactions. Perhaps this is becoming increasingly true as "firmness," "structure," and "discipline" in handling problems are again becoming fashionable. Phillips & Johnson (72) report the results of limiting a therapeutic sequence with a family to 10 interviews, a limit which is known to the family and therapists when therapy is begun and which gives the sequence some structure, a beginning, middle, and end. The therapy was an "application of Sullivanian principles to child guidance," and tried to help the parents "to give firmness, assurance, and dependability to the disciplinary situation." The authors report 16 cases, all successful or improved. There were fewer premature terminations than with conventional methods.

Several investigators have used ratings of improvement as the criterion of success in therapy. Rosenberg (79) asked each of 10 therapists to name two patients he had treated who had definitely improved over a nine-month period of psychotherapy, and two who had not. The 40 cases were selected from a pool of 400 VA Mental Hygiene Clinic patients diagnosed psychoneurotic. Half of the cases were examined for differences on the Wechsler-Bellevue, Rorschach, and sentence-completion tests which had been administered before therapy was begun. The improved group showed higher IQ, greater productivity, greater emotional depth and responsiveness, more sensitivity and tact, and higher energy level and drive for achievement. The unimproved were more stereotyped and more preoccupied with bodily symptoms and physical complaints. Two judges were informed of these results and were asked to guess the outcome for the remaining cases. One was correct on 16 of the 20 cases; the other, on 15. The number of cases is small, but well-classified on the criterion, and one would like to see a double cross-validation design, or a selection of predictors from an analysis of all improved against all unimproved cases, looking forward to cross validation on other samples.

Gallagher (38) also used extreme groups. High scores on the Taylor Anxiety Scale and on the Depression Scale of the MMPI, and a large number of words used to describe the problem for which the patients referred themselves were found to be associated with relatively greater improvement. Dana (22) utilized the scoring of responses on Card IV of the Rorschach to predict success in therapy. His data show that good form-quality was associated with better outcome; confabulation, contaminations, gross distortions, bizarreness, etc., were associated with poor outcome. The rationale for the study was the presumed relevance of responses on Card IV to the perception of and adjustment to authority, a problem not approached by the research design.

In summary of this set of studies it may be said: if groups are well enough separated on the criterion variable, it is likely that valid sets of predictors can be found. These will vary from study to study, depending on the kind of patient, the kind of therapy, the skill of the therapist, and other factors. Validity coefficients will be low. As with many ability and interest

tests used in vocational selection, it will probably be necessary to develop local norms and cut-off points.

*Personality changes associated with therapy.*—Rogers & Dymond (76) edited a report by eight authors on the personality changes accompanying client-centered therapy. In formal outline the design meets many objections which have been raised to previously reported research. The personality variables selected for study were those that might be expected to change on the basis of a consistent theory of personality and therapy, the nature of the therapeutic procedures is described, groups not receiving therapy were used to control for changes occurring as a function of time and repeated testing, and follow-up studies were conducted to check on the permanence of the changes produced.

Some of the important conclusions concerning the effects of therapy and the kinds of data on which they are based can be summarized briefly (without the qualifications so carefully considered by the authors). The client's perception of himself becomes more like that of the person he would like to be, and more like his conception of other people (based on an increase in the correlations between *Q*-sort descriptions of the self, the ideal-self, and the "ordinary person"). The self changes in the direction of increased inner comfort, greater confidence and optimism, and more comfortable relations with others (based on changes in the self *Q*-sort when the items are scored for "adjustment"). There is movement away from severe maladjustment toward the characteristics of a well functioning person (based on changes in TAT's administered before and after therapy). There is a tendency, not definitely established, for the clients who show the greatest therapeutic change to become more accepting of other people and more democratic (based on changes on scales measuring authoritarianism). When therapy is judged successful by the counselor, the client appears more mature, less dependent, better organized, and more tolerant (based on changes on the Willoughby Emotional-Maturity Scale as filled out by the client and two of his friends).

Such a bald summary cannot do justice even to the main findings, nor in fact can the authors' own accounts adequately describe group trends in the complex data compiled on individual cases. Two of these are presented in detail (175 pages), a successful case and a failure. It is a pleasure to work through the test scores, the TAT protocols and their analyses, innumerable *Q*-sorts by the client and by the counselor, the intercorrelations of all of these and several factor analyses, all against the background of the detailed account of the process of therapy.

Since the study is so well reported and the authors so willing to consider alternative hypotheses, one feels free to comment on the methods. At the time of application, the experimental group was given a battery of tests, and half of the cases were asked to wait two months before beginning therapy in order that changes occurring as a function of time could be estimated. However, some cases were started in therapy immediately because of their apparent need for it rather than because they were chosen by lot. Although

the groups as finally composed are well matched on several variables, this selective factor may have biased some of the results. A second estimate of changes with time and repeated testing was provided by a group who were paid for participating in the personality studies. They were not matched with the experimental group for test scores on variables expected to change with therapy; hence comparisons on amount of change have little meaning.

It is perhaps unnecessary to point out that all of the instruments used are some variation of self- or counselor-report (even the Willoughby filled out by friends), and they are vulnerable to attitudinal and motivational determinants which may not carry over into situations outside of the counseling center. One would like to know more about the measurement properties of some of the procedures, especially the *Q*-sort. A correlation between self and ideal-self has little meaning unless one knows something about the factorial composition of the items. It is likely they contain a large general factor since many of the items have very similar "face meanings," and most of them can be arranged along an adjustment continuum. When the ideal *Q*-sorts are scored for adjustment, the average score for all of the subjects comes fairly close to the maximum possible score. The self-ideal-self correlations are closely related to the self-sort scored for adjustment; therefore it seems likely that the general factor, some "summary statement" the client makes to himself about his degree of maladjustment, perhaps un verbalized, contributes largely to the placement of the items in the self-sort.

The over-all consistency of the findings leads the authors to be optimistic about the promise of further research of a similar kind. Most readers will share their optimism, because the method of client-centered counseling and its theory show no signs of becoming frozen in their present form. The theory becomes more complex as practice changes, and apparently the practice has changed, because the average number of interviews is larger than reported in earlier studies. However, the process of counseling is not the primary interest in this report, perhaps because it has been described in other years.

In other studies of personality and therapy, investigators have looked for changes in authoritarianism scales and related devices. Their results are inconsistent, and their interpretations of the meanings of the scales even more so. Gordon & Cartwright (46) use the scales to measure "acceptance of and respect for others" and interpret regression from extreme scores as increasing "openness to experience." Tougas (107) speaks of extreme scores as indicating a failure to achieve, or loss of "selfhood." Persons who score in the middle of the range (mildly antiethnocentric) have a balance between "individualism and conventionality," and were more successful in therapy. Pearl (71) found that group therapy produced more change (lower scores) than individual therapy and interprets this in terms of transference and the displacement of hostility. Rosen (77) takes an increase in scores during hospitalization to mean a more efficient defensive handling of conflicts. Clearly these scales have equivocal meanings and other limitations as well: the impure factorial structure of the items and the scales [O'Neil & Levinson (67)], a substantial correlation with measured intelligence, and vulnerability to test-



taking attitudes and response sets. Investigators would do well to find or devise more direct methods for measuring the phenomena they wish to observe.

Studies by Nunnally (66) and Osgood & Luria (69) are important because of the novelty of the methods used. Nunnally constructed 60 *Q*-sort items based on interview and test data for a subject who later began client-centered therapy. The subject sorted the items with several suggested sets: as she generally is, as she would like to be, as she is regarded by her parents, as they would like her to be, and as she is regarded by friends. From the inter-correlation matrix of 15 such sorts, three factors were derived. After therapy, 18 *Q*-sorts were factor analyzed, and the factors rotated to match the pre-therapy factors. The hypothesis that self-assessments would converge upon a central vector (a general factor) with successful therapy was verified, and the method recommends itself as a criterion of outcome. The first factors, pre- and posttherapy, were highly correlated but the second pairs were not, i.e., the factors (orthogonally rotated) transcend the content of the items. At two different times a subject may choose quite different *Q*-sort items to express an enduring incongruence between self and ideal-self. The finding is an extension of what Murray calls the "irrelevance of actones," and, in general, the clinically well-grounded notion that meaningful relationships exist not in overt behavior (the item-content of the *Q*-sorts) but in underlying dynamics (the factors).

Osgood & Luria (69) utilized the semantic differential to study a case of multiple personality previously reported by Thigpen & Cleckley (106). Fifteen concepts, some representing significant persons for the patient, e.g., father, mother, spouse, the self, and others abstractions, e.g., fraud, love, self-control, were rated by the patient on 10 scales and scored on three dimensions: "evaluation" (valuable-worthless); "potency" (strong-weak); and "activity" (active-passive). Three-dimensional geometric models were constructed for each of the patient's three "personalities" at two points in time, two months apart. A blind analysis of the consistencies and changes over time within the three personalities and the contrasts between them converge neatly enough with the clinical data to suggest that the method may be quite useful in tracing changes through the course of therapy. The method may be less vulnerable to conscious sets than *Q*-sorts and other forms of self-description.

*Physiological changes accompanying therapy.*—Physiological changes continue to attract attention as possible measures of the course and outcome of psychotherapy. They may be particularly relevant for some kinds of patients, for example those presenting autonomic and skeletal-muscle signs of anxiety at the start of therapy, or physical symptoms as in the psychosomatic disorders. The measurement of change in both patient and therapist simultaneously is proposed by DiMascio *et al.* (15, 25). They illustrate moment-to-moment changes in the heart rates of the therapist and patient and the differential effects of three interviewers on three different subjects. Over the course of 38 interviews with one patient there were periods when the



therapist's rate and variability were higher than the patient's, periods when their rates were concordant, and others when they were discordant. Heart-rate variability was high "when the positive transference was high." Respiration, finger temperature, and skin resistance were measured on the patient in addition to heart rate, and there seems to be no reason why these functions could not be obtained from the therapist as well. Sound recordings were analyzed by the Bales categories, which proved inappropriate because more than 80 per cent of the patient's responses were scored as "gives orientation" and "gives opinion," and similarly, the therapist's behavior was inadequately characterized.

Bixenstine (13) showed a decrease in palmar sweating in one subject through a course of therapy, stabilizing at a lower level and remaining low over a period of several months. Variations from the beginning to the end of a therapy hour were almost as great as the over-all change. In the early stages of therapy the level tended to be lower at the end of the hour; in the later stages, it tended to be higher, an illustration of Mowrer's "inverted V" effect. The subject and his wife tended to correlate positively from day to day, but their diurnal variations were negatively correlated; "one anabolizes while the other catabolizes."

Shagass & Malmo (87) offer the most provocative report in this series, because they paid attention to the events of therapy as well as to physiological measurements. They measured muscle potentials from five areas of the body during nine interviews with one patient. Hostile content in the interviews was associated with increased tension in the arm; sexual content, in the leg. The response was related to the identity of the person being discussed, rather than an awareness of emotion, a finding which suggests that the tension recorded is a response to unconscious attitudes. Muscle tension was slightly greater when hostility was not overtly expressed. The averaged tension over the five areas was correlated with nurses' ratings of mood and declined with therapy.

The possibilities suggested by these studies and many others from previous years are so intriguing that it seems strange that the methods have not been more systematically exploited. In part the difficulties have been technical and the problem of data reduction and analysis has been an imposing one (Shagass & Malmo got three miles of records). Ax (5) is currently working out methods for feeding the measurements of 10 or more physiological functions into high-speed computers, and statistical methods of profile analysis may provide further evidence on the patterning of responses characteristic of individuals and of particular emotional states as found by Lacey (58) and Ax (6). It seems likely that patients will respond characteristically to different kinds of interview content and dynamics, and changes in the patterning of their responses over time may be expected. Physiological data may be relevant to other problems: sudden shifts not discernible in overt behavior may be cues to important unconscious activations, and these "punctuation marks" may help to establish units of therapy, the beginning and end of a sequence; or the fading of a particular response as in Shagass and

Malmo's patient may provide some kind of criterion for the "working-through" of a conflict. Although sampling from time to time through a therapeutic series will be of interest, perhaps the most effective use will be in connection with a detailed analysis of the sequence of events in the patient-therapist interaction like that described in the Eldred *et al.* study (29) (see below).

*The effectiveness of psychotherapy.*—The matter of outcome cannot be left without some reference to the worth of the whole enterprise: does psychotherapy do any good? The year saw the closing of the interchange between Eysenck and Rosenzweig, Eysenck (31) restating his agnostic position, or more elegantly, that the null hypothesis with respect to the effects of psychotherapy has not been disproved. Rosenzweig (81) granted the logic of his position but wished that Eysenck would write less connotative prose.

Eysenck's disbelief will not be shaken by two recent studies comparing the effectiveness of psychotherapy and other methods. Harris (51) reports only a very slight advantage for psychotherapy over carbon-dioxide inhalation, although the patients treated with psychotherapy were more willing to assert that their treatment had been helpful. The criteria of change were fairly objective, but still involved some element of personal judgment, always suspect even by persons less hard-headed than Eysenck. A similar report by Hargrove, Bennett & Steele (50) is no more convincing, although the differences again favored psychotherapy over carbon dioxide, this time at a high level of statistical confidence. Initial status was less well controlled than in the Harris study, and the criterion again involved subjective judgments. Thirty-four per cent of the carbon-dioxide patients left treatment before the series was considered complete; only 8 per cent of the psychotherapy patients terminated "prematurely."

Negative evidence is not likely to deter many psychotherapists from continuing to treat patients, nor patients from seeking their services. Twenty years ago Carney Landis welcomed the advent of electroshock and insulin therapy. He considered their therapeutic effectiveness an irrelevant question; the important thing was that these drastic procedures, employed for ethically sanctioned reasons, provided an opportunity to observe changes under conditions not otherwise available to the research worker. Although we still do not have really critical data on the therapeutic effectiveness of these methods, we have learned a good deal about their effects on psychological processes, and neurological theorizing about cortical functions has been much enriched. The same is true of psychotherapy; our notions about psychopathology would be quite different were not patients exposed to prolonged psychotherapy.

#### THE PROCESS AND TECHNIQUE OF INDIVIDUAL PSYCHOTHERAPY

Although the interaction of patient and therapist is the primary focus of many theoretical and clinical papers, the number of formal studies reporting direct observations of the interaction is small. In a review of research in clinical psychology for 1953, Schofield (84) found only three studies using

sound recordings of therapeutic interviews, a frequency which placed them in the fourteenth rank among his categories of research topics, although they had been second in 1949. Apparently the method has not proved as productive as seemed likely in the early days of wire and tape recorders. The sheer amount of data to be somehow coded and reduced, and the difficulty of defining meaningful units and kinds of events have presented difficult problems.

Eldred *et al.* (29) considered several problems involving patient-therapist interactions and elected to limit their study to: "drastic changes in subject," the conditions under which they occur, and their effects on the communication between patient and therapist. They noted in sound recordings and typescripts: (a) direction of change of subject toward more or less direct communication; (b) awareness of change of subject by either patient or therapist; (c) the initiator of the change, patient or therapist; (d) techniques of change (for example, introducing emotionally laden material about a matter other than that under discussion); and (e) causes of change of subject (for example one of the participants becomes anxious about the subject under discussion). A number of findings emerged, some of which were contrary to expectations. Changes of subject tended to increase communication. Changes were more often conscious, and when they were unconscious they tended to decrease communication, a finding which the authors relate to French's thesis that the factor of a goal in the therapeutic situation accelerates the process. The absence of initial pleasantries at the beginning of an hour leads to a "more conjunctive integration of patient and therapist." The patient-therapist pairs differed markedly on some of the variables. As a further step in the research, the patients and therapists will be reshuffled.

In another study of recorded material, Murray, Auld & White (62) report an application of the Discomfort Relief Quotient and a method of content analysis to a treatment sequence with a patient previously reported by Dollard *et al.* (27). The frequencies of four categories of content (subject matter and feeling tone) were plotted over the course of 17 interviews. Hostility toward the patient's children and her mother was high during the first third of the sequence, then dropped rapidly. Conflicts about the husband rose during the first third and remained at a high level. General hostility toward the husband rose during the first third, then declined. Sex-conflict with the husband appeared in the second half of the sequence and rose to a high level. The sum of the number of statements in these four categories showed no change over the period of the therapy, nor did the DRQ change. The content analysis agrees well with the free-hand summary by Dollard *et al.*, and this fact is taken as evidence that the content analysis "measures meaningful and theoretically significant things."

*The personality, attitude, and behavior of the therapist.*—The study of therapist behavior may yield information about the nature of the therapeutic process. For example, it has often been asserted that some kinds of therapists communicate easily with schizophrenics and that they are therapeutically effective with such patients. Whitehorn & Betz (110) attempted to identify the characteristics of the therapist who is successful with schizophrenics and

concluded (a) in his diagnostic formulation the successful therapist pays attention to motivation and personal meaning of behavior beyond clinical description and narrative biography; (b) in setting goals, he selects "personality oriented" rather than "psychopathologically oriented" goals, i.e., modifications of personal adjustment rather than decrease of symptoms; and (c) he makes use of "active personal participation" rather than "passive-permissive," "interpretation and instruction" and "practical care" patterns. Analysis of the data which the authors present suggests that the improved patients were indeed judged to have been treated by the type of understanding and treatment listed in the conclusions. However, it is not clear from their data that these were the critical factors in determining improvement. The finding that the therapists who were most successful with schizophrenics were not also more successful with other kinds of patients casts doubt on the validity of the method, a doubt which is strengthened by the fact that there seems to be little reason to believe that the characteristics listed for the successful therapists should be specific to the treatment of schizophrenia; actually they represent attitudes and methods currently fashionable in most psychiatric residency training programs.

Two papers describe attempts to study therapist behavior in a controlled setting. Strupp (100) asked therapists to respond to 27 statements culled from interviews with neurotic patients. The short paragraphs contained complaints, suicidal threats, examples of blocking and negativism, requests for direct advice, and open expressions of hostility. Therapists' responses were coded by the Bales categories. Only fair distributions were obtained, some categories being too inclusive, others used only infrequently. Psychiatrists tended to give more interpretive responses than psychologists and social workers; both psychiatrists and psychologists showed more passive rejection, and the social workers gave more reassurance. Experienced therapists used more interpretations, more passive rejections, and fewer exploratory responses. Apparently the inexperienced therapists followed the guide: "when in doubt, ask questions."

Sommer, Mazo & Lehner (92) edited the tape of a therapeutic hour to eliminate the therapist's verbalizations. The rest of the tape was divided into 12 units "which were meaningful segments," each about one minute long. Nineteen therapists, varying in amount of experience, were asked, after each segment, "What has the patient told you?" Most of the observers responded with "content" statements, e.g., "She hates her mother," and the more experienced tended to give interpretive rather than descriptive statements.

How valid a picture these methods give of therapists' activities is questionable. The laboratory setting is artificial, the units are short, and one cannot be sure that the therapists would respond similarly in an actual therapeutic situation where a large body of context is available to them. However, the procedures can be thought of as tests, and systematic connections with "naturally occurring" therapeutic behavior can be sought. The approach recommends itself as a training device.

One may turn to patients' reports for an account of what happens during therapy. Lipkin (60) utilized this little explored source of data by asking nine patients to dictate into a recording machine their impressions of what had happened during each preceding therapeutic hour. At the end of therapy (client-centered) a "focussed interview" with someone other than the therapist provided an overview of the patient's experience in treatment, his evaluation of the treatment, his estimate of the changes produced, etc. The dictated summaries were analyzed in nine categories, e.g., perception of the self, past and present; and feelings and attitudes about the counselor and the counseling process. Ratings showed the direction (positive, negative, ambivalent) and intensity of affect. The cases showing the largest change on TAT's scored for neurotic tendency, anxiety, etc., were found to have discussed themselves and their problems with more emotionality, and had come to see themselves more favorably. Those changing less tended to discuss their attitudes toward the counselor, and there was a negative correlation between outcome and the number of remarks about the counselor. Lipkin calls this defensiveness and "repression of affect with respect to the self." In other therapeutic contexts it is called transference. One wonders how this was expressed in the therapeutic hour, and how it was handled by the counselor. Was he aware of it, and did he attempt to interpret the resistance? The next step in this kind of research is inevitable: both patient and therapist dictate their impressions immediately after the hour. It would be of great interest to see the method applied to other kinds of therapy.

*Some clinical reports of technique.*—Over the last decade or so a number of child centers have undertaken psychotherapy with more than one member of a family, often a child and both of his parents, and occasionally with three generations of a family, either by a single therapist or by several working in collaboration. Szurek (104) reports such an effort with several adolescent girls and their parents. The complexity of the interactions becomes immediately apparent, for example when the sexual delinquency of an adolescent girl "revengefully caricaturizes" the unconscious attitudes of the mother. The details of the method are only sketched and the reader is referred to previous publications in the series. Sufficient evidence is presented, however, to make it clear that changes in one patient are reflected in the course of therapy with the others, and that as the "neurotic nexus" between a mother and her daughter, for example, becomes loosened, both begin to have more satisfying relations with other persons. Therapeutic study of child and parents over a period of years allows one to see the "neurotogenic" factors in process, and provides data of a quite different order from the recollections of childhood experience by adult neurotics.

Stokvis (95) describes a group method similar to David Levy's attempts in individual therapy to restage a traumatic event in a child's development. Four 12 to 15-year-old enuretic boys who had lost their parents when quite young were asked to act out roles and plots derived from difficult episodes they recalled from their past lives. It was thought that they experienced in the

psychodramas an intensity of affect appropriate to the original event, but with different behavioral consequences, for example hitting back instead of protesting mutely. The method deserves further exploration.

Goldfarb & Sheps (43) report an interesting manipulation of transference phenomena in the therapy of older persons. Fear and rage arise in the context of increasing helplessness attributable to loss of physical, social, and economic resources. The patients thrust the role of a powerful parent onto the therapist. In 5 to 15 min. interviews, the therapist allows the patient to gratify his needs for punishment, affection, respect, and protection. In a kind of manipulative role-playing, "therapy made use of patients' delegation of power to the psychiatrist to provide the illusion that the latter was mastered and his powers were available to them." Success of the method is thought to rest on the patient's "secret and somewhat contemptuous conviction that he has tricked and overpowered the doctor."

Other clinical reports like these could be listed, and to run through such accounts in the periodical literature gives one the impression that practicing therapists possess a good deal of shrewdness in handling the problems of persons who seek their help. The rationale of their techniques is unsystematic, and their methods have been learned by apprenticeship and experience. It probably does not occur to many of them to submit their methods to scientific scrutiny, any more than it does to a cabinet maker or a sculptor. A compendium of methods is offered by Wolberg in *The Technique of Psychotherapy* (112), practically a recipe book. Wolberg gives hints on what to do in almost any situation that may arise in therapy, from what to do when the patient inquires about the therapist's health to what to do when he doesn't pay his bill.

Some notion of the attitudes of practicing therapists and of the gap between theory and practice comes from a survey of opinions Wolff (113) elicited during interviews with 43 "leading therapists of various schools." Three-quarters were dissatisfied with the "theoretical framework" they use. Only 10 per cent claim to follow up their patients systematically, and 34 per cent do so occasionally. Another 34 per cent leave the initiative to the patient, and 22 per cent "do not care for follow-ups." Almost half denied that the personality of the therapist influences the patient and most of these thought it should not, a remarkable finding in view of the current theoretical interest in countertransference (see below). When asked about the most frequent personality changes after therapy, 27 per cent responded "development of ego strength." The others scattered over seven categories. One would suspect that goals in therapy are not well expressed by these abstract categories, and that techniques and goals vary according to the concrete problems presented by the patient.

#### PSYCHOANALYSIS AND PSYCHOANALYTIC THERAPY

*Training in psychoanalysis.*—An interesting historical note on the development of the American Psychoanalytic Association is provided by Knight (57). By 1952 the membership of the Association had grown to about 500



members, and at present there are twice as many students in training as there are members. It is not known how many of these students will go on to become members, because membership implies an accreditation of competence as well as a professional interest. Concerning the nature of these students, Knight makes the following comments:

In the 1920's and early 1930's those who undertook psychoanalytic training were of a somewhat different breed from the current crop of candidates. There was, in those days, less emphasis on selection procedures and many analysts were trained who might today be rejected. Many training analyses were relatively short, and many gifted individuals with definite neuroses or character disorders were trained. They were primarily introspective individuals, inclined to be studious and thoughtful, and tended to be highly individualistic and to limit their social life to clinical and theoretical discussions with their colleagues. They read prodigiously and knew the psychoanalytic literature thoroughly. Many of these have become our best teachers, theoreticians, and clinicians. . . . In contrast, perhaps the majority of students of the past decade or so have been "normal" characters, or perhaps one should say had "normal character disorders." They are not so introspective, are inclined to read only the literature that is assigned in institute courses, and wish to get through with the training requirements as rapidly as possible. Their interests are primarily clinical rather than research and theoretical.

A consequence of the increased number of candidates is a concern with methods of training. Because of the increasing influence of psychoanalysis on the practice of psychotherapy in this country, it is of interest to examine what is considered necessary for the training of an analyst. Balint (9) attributes the increasing length of training analyses to a recognition of the importance of aggressive impulses and negative transference. Some trainees in these long analyses come to identify with the hated object, the analyst, and to idealize him with a consequent "confusion of tongues, power politics, and hostility within analytic groups."

Heimann (52) discusses the difficulties entailed by the training analyst's multiple functions as a teacher, supervisor, potential friend, and colleague, and the fact that he must make major decisions for the candidate. Her recommendation is a strict adherence to analytic technique, free association for the candidate, and "freely floating attention" for the analyst. Both Heimann and Bibring (10) discuss the countertransference problems of the analyst and his narcissistic needs and conflicts. They recommend self-analysis, but Bibring quotes Bernfeld's wry comment, "Self-analysis would be extraordinarily helpful were it not for the countertransference."

Gitelson (42) is impressed with the difficulties of analyzing candidates for training:

Thus in a social setting in which aggressiveness, ambition, and hard work have a high premium attached, a gifted analysand can live through his analysis as he has lived through his life, cleverly disguising his neurosis. Normality, a symptom, is not suffered from as such. On the contrary, it is capable of earning social rewards of which the first is acceptance as a candidate. To no other symptom does such a large quota of secondary gain attach.



Weigert (109) makes countertransference the focus of her discussion. It may be a tool allowing the analyst to understand a patient through identification, introjection, or empathy, and hence to widen his own experience. It also may make him anxious, but hopefully less so than the patient (trainee). Her accounts of experiences with young analysts and supervisees make the whole enterprise of therapy and training seem more adventuresome and rewarding for the analyst than it would be in the hands of someone who is "completely analyzed" and can maintain "true equanimity" in the face of the fascinating things that patients and trainees do and the tales they recount.

Nielsen (65) quotes a candidate: "You, my analyst, have been analyzed for 300 hours by a man who was analyzed for 150 hours by someone who was not analyzed at all." In commenting on the problems of the training analyst, Nielsen states: "The preceptor attitude of the analyst . . . may have undesired complications. It may play the role of the all too strong wish to help and cure the patient [read candidate]. The wish to mould a man in one's own image is so ubiquitous that not even God is exempt from it." He suggests that training institutes accept gifted aneurotic, well adapted candidates with due regard for the fact that they cannot be analyzed intensively, and give them short didactic analyses and painstaking control of their therapeutic activities. Grotjahn (48, 49) alone among the contributors comments on classroom teaching and assigns it minor importance. These discussions seem to be guided primarily by a concern for the differences between a training and a therapeutic analysis. One wonders what kinds of papers would be elicited by the simple question "What is required for the practice of psychotherapy?"

*The treatment of psychoses.*—Fromm-Reichmann (35, 36) summarizes the conclusions of her research group at Chestnut Lodge: unending love, permissiveness, and understanding by the therapist cannot make up for the lack of love experienced by schizophrenics in childhood. Like neurotics, they must learn to integrate the early loss and to understand their own part in their interpersonal difficulties with the significant people of their childhood. Too much sympathy may invoke a chain of dependent attachment, resentment, anxiety, and symptom formation. Schizophrenic symptomatology is an expression of and defense against anxiety. ". . . The universal human experience of tension between dependency, fear of relinquishing it, recoil from it, and interpersonal hostility becomes, in the case of schizophrenic persons, so highly magnified and so overwhelming that it leads to unbearable degrees of anxiety and then to discharge in symptom formation." These points are amplified and illustrated with clinical data in papers by Szalita-Bemow (103), Searles (86), and Burnham (17).

Numerous clinical-theoretical papers report therapeutic experience with psychotic patients [cf. Bion (12); Katan (55); Bychowski (18); Eissler (28); Cohen *et al.* (20), the last on manic-depressive psychosis]. Their content does not lend itself to brief summary. A review by Stone (99) evaluates the work of Schwing (85) and Rosen (78), who represent two focal points in the area which is currently the most active scene of psychoanalytic investigation.

*The differentiation of psychoanalysis from psychotherapy.*—Psychoanalysts have been exclusionist in building their society [cf. Knight (57)], but exuberantly expansionist with respect to the kinds of patients they have attempted to understand and treat. The history of the widening scope of analysis is presented by Stone (98) and Anna Freud (34). An important theoretical concept central to this development is the countertransference of the therapist; it is discussed by Weigert (108) and Greenacre (47) and in a scholarly if somewhat tedious review by Orr (68). Many of the papers seeking to clarify the nature of psychotherapy proceed by a series of definitions [Rangell (73); Gill (40); Bibring (11)]. In contrast, Fromm-Reichmann (37) and Alexander (2, 3) attempt to give a theoretical account of the modifications of method they have introduced for the treatment of schizophrenia, character problems, and patients with psychosomatic disorders. A novel formulation of the differences between psychoanalysis and other kinds of psychotherapy in terms of role-theory, and the disequilibrium created when the analyst does not assume the role complementary to the one the patient has assumed are discussed by Spiegel (94).

One gets the impression that the storm created by the controversial Alexander & French volume (4) and other departures from orthodox method is blowing itself out. The fact that it occurred at all is a sociopsychological problem. Erikson (30) comments:

Psychoanalysis as a movement has harbored a variety of world images and utopias which originated in the various states of its history in a variety of countries, and this as a result of the simple fact that man, in order to be able to interact efficiently with other human beings, must, at intervals, make a *total orientation out of a given stage of partial knowledge*. Individual students of Freud thus found their identity best suited to certain early theses of his which promised a particular sense of psychoanalytic identity, and with it, an inspiring ideology. Similarly, overstated antitheses to some of Freud's tentative and transient theses have served as bases for professional and scientific identities of other workers in the field. Such identities easily find elaboration in ideological schools and in irreversible systematizations which do not permit of argument or change.

#### GROUP PSYCHOTHERAPY

To speak of group psychotherapy in the singular is a matter of convenience, not of reality, for if one single characteristic can be selected to typify the growth of this "discipline" it is diversification. Practice varies with respect to underlying hypotheses, the nature of patient populations, the settings in which therapy occurs, the atmospheres created, therapists' roles, criteria for selection of patients, conduct of the therapeutic sessions, and methods of evaluating outcome. It would appear that "success" is possible with many different modifications depending upon the comfort of the particular therapist with his choice of method.

A survey of the literature for the past year indicates, however, that practitioners in the field are coming to recognize the value of systematizing their knowledge, integrating their concepts, and evaluating their results. Many articles are still of the "I did group psychotherapy with alcoholics" variety,

without concern for conceptualization or with objective evaluation. Such articles may be of interest to therapists seeking consensual validation of their own experiences.

The most comprehensive and systematic attempt to integrate theory and practice, conceptualization and application, description and evaluation, is Bach's *Intensive Group Psychotherapy* (7). Bach has had training and experience in academic psychology, in group dynamics, in psychoanalysis and in individual and group psychotherapy. His book combines these areas in a challenging, although necessarily tentative, manner.

Bach's exposition is complicated by the variety of theoretical notions upon which he draws. His basic allegiance seems to be to Lewin (usually as interpreted by Cartwright and the Michigan group). But translation of group-dynamics principles to the operations of group psychotherapy necessitates his drawing extensively upon Sullivan, whose contemporaneous approach is more congenial to him than Freud's historical orientation, upon Bion and the Tavistock group, Powdermaker and Frank, and Ruesch and Bateson.

The sections of the book concerned with theoretical integration are less consistently rewarding than those which combine theory with concrete applications, perhaps because group psychotherapy has not developed to the point where integration is always possible. Another reason lies, however, in the author's attempt to be inclusive, even when the principles are not appropriate to a discussion of the way he, as a therapist, works with groups. The remoteness is immediately evident in the decreased communication value of such sections, even as the life of other sections is enhanced by direct experience.

Bach's book is unique in several other respects. One is his use of especially-developed diagnostic techniques for assigning a patient to a group. These include asking the patient to group figures from the Make a Picture Story Test as an estimate of relative degrees of peer and authority difficulties, Lewin Life Space drawings evaluated in the light of distortions and omissions, and actual visits to group sessions before placement to insure "interpersonal fit."

Another contribution is Bach's outline and theoretical rationale of the wide variety of procedures he utilizes. These include role playing, sociometrics, dream analysis, "going around" (to each patient in turn), projective drawings, etc. Bach's role as a therapist is unquestionably "active," and he details his reasons for each type of activity.

Of particular interest to many persons concerned with the relative effectiveness of individual versus group versus combined therapy will be Bach's discussion of his own bias in this regard. He feels that in order to increase the therapeutic effectiveness of group participation, concomitant individual-therapy must be group-oriented, i.e., focus on feelings which the group sessions themselves arouse.

Singer (90) has made the point that Bach nowhere attempts to evaluate outcomes of treatment. What he has done, it would seem, is to define group psychotherapy in a manner that will permit such evaluation.

*Other theoretical contributions.*—Among the shorter articles there are a number dealing with limited theoretical aspects of group psychotherapy. Hypotheses regarding the nature of transference in groups are shifting from the notion that transference is diluted in the group setting to the position that it is intensified. Representing the latter view, Demarest & Teicher (23) point out that unique transference manifestations, not found in individual psychotherapy, occur in groups. They cite five kinds of group transference: patient-patient, patient-therapist, patient-group, therapist-group, and therapist-therapist (when more than one person conducts the group). Moreover, they continue, three dimensions of each type of transference can be distinguished: directional flow, psychodynamic depth of the relationship, and intensity of the relationship (its primacy in influencing behavior). The group situation is complicated by the fact that each kind of transference must be dealt with by both patient and therapists. Their article is made concrete and meaningful by illustrations from group behavior.

Hulse (53) agrees that group psychotherapy intensifies, rather than dilutes, transference. He suggests that combined individual and group therapy has the additional advantages of increasing initial catharsis, providing opportunities for the integration of insight, and for testing reality against the responses of the other participants.

Delineating and understanding the characteristic roles adopted by group members can serve as an operational focus for formulating group dynamics. Rosenthal, Frank & Nash (80) have described several such roles, and the depiction of the "self-righteous moralist" is their most recent contribution. They describe a well-entrenched character disorder within which conflicts are resolved, with the role as a vehicle for such resolution. While undue concentration upon the role might result in neglect of the patient's communications, recognition of the manner of approach may enable the therapist to deal more effectively with the meaningful material.

Selection of patients for groups continues to be a "wide open" area. For each article insisting that a certain type of patient is totally unsuitable for treatment there seems to be a corresponding publication reporting a positive group experience with just such patients. Patient populations have included psychoneurotics, psychotics, psychopathic deviates, the mentally retarded, the physically handicapped, every variety of psychosomatic illness, senile-gerontological cases, alcoholics and drug addicts, the relatives of disturbed patients, etc. Several proposals for achieving order and rationale, if not unanimity, in this area have been advanced. Slavson (91), whose theoretical orientation has many adherents in this field, lists his criteria in a manner which ignores the possibility of disagreement. His four basic criteria are: (a) at least minimal satisfaction in primary relations sometime in childhood; (b) not too great a degree of sexual disturbance (these patients, he feels, should be treated individually); (c) enough ego strength to stand group stress; and (d) at least minimal superego development. He lists a great number of secondary indications which further limit the patient population he believes suitable. Additionally, Slavson feels that groups should be consti-

tuted in terms of homogeneous psychopathology. On this issue too, many other writers are in disagreement.

Freedman & Sweet (33) claim that group psychotherapy is best suited to three types of patients: (a) severely disturbed outpatients with tenuous reality ties; (b) patients intellectually or culturally unsuited to introspection; and (c) patients with rigid character defenses. Their viewpoint differs from Slavson's in many respects and in a sense confirms the notion that psychotherapeutic success may depend as much upon the convictions of the therapist as it does upon the character of the patient.

Stone, Parloff & Frank (96) feel that a patient's position on the dependence-dominance continuum is relevant to proper group placement. They suggest that temporary "diagnostic" groups provide valid observational data for such evaluation and reduce the waiting lists necessitated by extensive individual assessment. Their use of a group setting to determine suitability for group psychotherapy is complemented by Foulkes' (32) use of groups to provide indices for psychoanalytic treatment.

*Experimental evaluations.*—Groups of individuals in therapy are easier to amass than groups of groups, and the limitations imposed by this fact continue to hamper empirical studies. As a result, the direction of research is more often within-group, rather than between-groups evaluation.

An unusual type of group is seen in Cadman, Misbach & Brown's (19) modification of McCann's "round-table psychotherapy." The therapist is removed from the room altogether, and many workers in the field would question whether the resultant group can be labeled "psychotherapeutic." One point that seems generally agreed upon is that, regardless of the activity or inactivity of the therapist, his physical presence is necessary both to reduce anxiety and to facilitate transference responses. Even if the "therapy" label is removed, however, the obtained results command attention. The writers present data indicating that clinical improvement occurs in their experimental groups but not in "nontreated" controls. Apparently, the work orientation of the roundtable group is conducive to increased reality contact, whether or not it is termed "therapy." The appendix to this monograph gives clinical data on 16 patients, eight improved and eight unimproved. The authors failed to note that of the improved cases, five had been ill for less than a year, and all of the unimproved for longer than a year.

Leary & Coffey (59) attempt to predict interpersonal behavior in the group on the dimensions of dominance-submission and love-hate by means of empirically-derived MMPI indices. They find that the MMPI relationships hold only if the behavior is either extreme or invariant. Variability is described as structural (conflict within the personality), temporal, and situational. The authors suggest that predictions must be adjusted to take the variability factor into account, but they do not, at this time, offer a method for such correction.

Talland & Clark (105) contribute a neat study evaluating topics of discussion in groups. They had 43 patients in seven groups rank 15 topics on

eight dimensions relating to group and personal helpfulness, disruptive quality, and disturbing effect. There were no differences in rankings attributable to sex or marital status, and none of the 15 topics was universally considered useless. Helpfulness and disturbing effect were positively correlated. They found also that there was little relationship between helpfulness and judged intimacy of topics. There was significant agreement, both within and between groups on the relative helpfulness of the topics.

Another area subjected to evaluation was the "group atmosphere." Singer & Goldman (89) felt that evidence from authoritarianism research indicated that for certain emotionally disturbed individuals a highly structured situation is conducive to good morale. To test the consequences of this hypothesis for group psychotherapy, they acted as co-therapists for two matched groups of schizophrenic male veterans. One group was provided an "authoritarian" atmosphere, with didactic lectures and controlled discussions; the other group, a "democratic" atmosphere, modeled on analytic group psychotherapy. Each kind of group had certain advantages at different stages of treatment, and the authors conclude that initial structuring, followed by later permissiveness, is the most effective atmosphere.

The concept of effectiveness and the evaluation of outcome are complicated in group research, as in individual therapy, by inadequate independent criteria of improvement. Singer & Goldman used the highly questionable criterion of their own ratings of appropriateness of patients' interactions and verbalizations. Katzenstein (56) also evaluates "atmospheres," and his criterion was a patient's willingness to leave the hospital. However, neither the therapist nor the patient is an independent judge of improvement.

Baehr (8) gave more attention to the criterion problem in studying the comparative effectiveness of individual, group, and concomitant treatment. A discontentment scale measured the intensity with which each of 230 kinds of experience had troubled the patient in the week preceding his taking the test. The test was administered before and after therapy, and the improvement criterion consisted of an index of change from initial to final level. The mean movement-index was highest for patients receiving combined individual and group therapy, next for those having individual therapy only, and lowest for those having group therapy only. These differences were not significant, but when the patients receiving combined therapy are contrasted with those receiving either method alone, a significant difference does obtain. Baehr relates his findings to the mutually reinforcing effect of concomitant therapy and the catalytic effect of group therapy on individual sessions.

A more clinically oriented evaluation was undertaken by Sacks & Berger (82) who worked with hospitalized chronic schizophrenic patients. While the discharge rate for those in group psychotherapy was not different from the nontreated patients, the proportion of patients able to move to and stay on an improved ward was significantly greater for the treated groups. The authors saw four groups (a total of 28 patients) over a one-year period. They felt that important factors in treatment were: the active role of the therapists,



the consistency of the group structures, the building up of positive feelings and resolution of negative ones, reality-oriented comments, the separation of administrative from therapeutic functions, and their technique of playing back recordings as an aid to evaluating distortions.

The Sacks & Berger study is unique in that it specifies techniques and also attempts to evaluate outcome. More frequently, articles dealing with technique are descriptive only, and statements to the effect that the technique in question is appropriate for a certain patient population must be taken, or discarded, on faith. Occasionally, however, such reports are presented in a convincing manner, or known techniques are utilized in an original fashion, so that confidence in the validity of the techniques is easily engendered. For example, group psychotherapy has been used with relatives of patients for at least 10 years. The current literature proposes at least three extensions that seem both logical and meaningful in the light of this background.

Kahn & Prestwood (54) worked with parents of hospitalized adolescent schizophrenics. The novelty of their approach lies in the focus on the parents' own problems, as distinguished from those of their children, and on the facilitative role of the group in the patients' own individual therapy.

Abrahams & Varon (1) in a well-conceived and carefully recorded clinical study placed young adult schizophrenic women and their mothers in the same group. Confirmation of hypotheses about symbiosis between mother and daughter is found in the authors' reports of the therapeutic sessions. Behavior patterns are exhibited in context rather than in transference reflections. The suggestions regarding extension of this type of research to other parts of the family constellation are warranted by the wealth of their data.

The third modification of group therapy with relatives is reported by Shugart & Loomis (88). They used psychodrama with parents of hospitalized schizophrenic children. The device of "switching roles" is used by the writers as a source of diagnostic observation. Their primary focus, however, is educational rather than therapeutic. They emphasize the development and functioning of the healthy child to enable the parents to respond to growth processes in their own children. The value of the article is its novel use of psychodrama to "put the relative in the patient's shoes." For parents whose mode of interaction is to enforce emotional distance, such a technique might evoke insightful discoveries.

An overview of the current trends in group psychotherapy literature indicates that group therapy may be regarded as the treatment of choice for many patients, and, combined with some individual therapy, for most patients. It is not an inferior approximation of individual therapy, but a treatment method with unique characteristics. At the present time, both theory and practice of group psychotherapy are highly diversified, but communication about groups is increasing, and correspondingly, convergence of ideas in important areas is taking place.



## SUMMARY AND PROSPECT

Critical evaluations by reviewers of the literature on psychotherapy in previous years could be repeated here with undiminished relevance. A sluggishness in the field would make a five-year review not much different from an annual review, only longer. A factor analysis of the material would yield three factors: a theoretical interest, represented mostly by psychoanalysts; an interest in objective research, represented mostly by psychologists; and an interest in the practice of psychotherapy, represented by persons in several different professions. Simple structure would not demand oblique rotations and only the Rogerian studies would have significant loadings on all three factors. However, there is some evidence that the factors are becoming correlated. Some persons who are known for their clinical-theoretical contributions are submitting their techniques to public scrutiny via sound recordings, for example, Gill, Newman & Redlich (41), Fromm-Reichmann, Cohen and their co-workers (20, 35), and Deutsch & Murphy (24). Many research workers are trying to capture in experimental designs the complex phenomena of psychotherapy. The flow of communication between patient and therapist is elusive, and the problem of identifying meaningful sequences so that their changing character can be plotted against time and kinds of therapist activities has proved a formidable one. It has been recognized that a sentence-by-sentence analysis confines itself to too small units of the interaction, the significant events of therapy having indefinite time and action units. There may be hierarchies of units; in a long therapeutic effort a meaningful unit may be six months or a year or longer, even though the interval may be analyzed into smaller units with different properties and with different kinds of effects on the therapeutic process.

A number of tools are becoming available. Changes in the course of therapy may come to be identified by formal or nonverbal events, for example by the interaction chronograph, which is currently being restudied [Goldman-Eisler (44, 45); Saslow *et al.* (83)], by physiological changes, or by content-free speech analysis as developed by Soskin (93). Criteria for the "depth of interpretation" are being developed by Dittman and his co-workers (14, 26), and other dimensions of interpretation and kinds of therapist influence may yield to objective definition [cf. Eldred *et al.* (29)].

The increased participation of psychoanalysts and other kinds of therapists in psychiatric hospitals and medical schools may provide the background for productive liaison between research workers with different kinds of skills, and the creation of psychotherapeutic research institutes like the Clinical Center of the National Institute of Mental Health (Bethesda) may further facilitate the enterprise.

## LITERATURE CITED

1. Abrahams, J., and Varon, E., *Maternal Dependency and Schizophrenia* (International Universities Press, Inc., New York, N. Y., 240 pp., 1953)
2. Alexander, F., *J. Am. Psychoanal. Assoc.*, **2**, 722-33 (1954)
3. Alexander, F., *J. Am. Psychoanal. Assoc.*, **2**, 685-701 (1954)
4. Alexander, F., and French, T. M., *Psychoanalytic Therapy* (The Ronald Press Co., New York, N. Y., 353 pp., 1946)
5. Ax, A. F., *Polygraph Newsletter*, **1**, 11 (1955)
6. Ax, A. F., *Psychosomat. Med.*, **15**, 433-42 (1953)
7. Bach, G. R., *Intensive Group Psychotherapy* (The Ronald Press Co., New York, N. Y., 446 pp., 1954)
8. Baehr, G. O., *J. Consulting Psychol.*, **18**, 179-83 (1954)
9. Balint, M., *Intern. J. Psycho-Anal.*, **25**, 157-62 (1954)
10. Bibring, G. L., *Intern. J. Psycho-Anal.*, **25**, 169-73 (1954)
11. Bibring, E., *J. Am. Psychoanal. Assoc.*, **2**, 745-70 (1954)
12. Bion, W. R., *Intern. J. Psycho-Anal.*, **35**, 113-18 (1954)
13. Bixenstine, V. E., *J. Abnormal Social Psychol.*, **50**, 138-43 (1955)
14. Bordin, E. S., Cutter, R. L., Dittman, A. T., Harway, N. I., Raush, H. L., and Rigler, D., *J. Consulting Psychol.*, **18**, 79-82 (1954)
15. Boyd, R. W., and DiMascio, A., *J. Nervous Mental Disease*, **120**, 207-12 (1954)
16. Braatoy, T., *Fundamentals of Psychoanalytic Technique* (John Wiley & Sons, Inc., New York, N. Y., 404 pp., 1954)
17. Burnham, D. L., *J. Am. Psychoanal. Assoc.*, **3**, 67-81 (1955)
18. Bychowski, G., *Intern. J. Psycho-Anal.*, **35**, 147-53 (1954)
19. Cadman, W. H., Misbach, L., and Brown, D. V., *Psychol. Monographs*, **68**(13), 48 pp. (1954)
20. Cohen, M. B., Baker, G., Cohen, R. A., Fromm-Reichmann, F., and Weigert, E. V., *Psychiatry*, **17**, 103-37 (1954)
21. Cronbach, L., *Psychol. Bull.*, **52**, 177-93 (1955)
22. Dana, R. H., *J. Clin. Psychol.*, **10**, 350-53 (1954)
23. Demarest, E. W., and Teicher, A., *Psychiatry*, **17**, 187-202 (1954)
24. Deutsch, F., and Murphy, W. F., *The Clinical Interview*, **I, Diagnosis, II, Therapy** (International Universities Press, Inc., New York, N. Y., 1954-1955)
25. DiMascio, A., Boyd, R. W., Greenblatt, M., and Solomon, H. C., *Diseases of Nervous System*, **16**, 4-9 (1955)
26. Dittman, A. T., and Rausch, H. L., *Psychol. Rev.*, **61**, 386-400 (1954)
27. Dollard, J., Auld, F., and White, A., *Steps in Psychotherapy* (The Macmillan Co., New York, N. Y., 222 pp., 1953)
28. Eissler, K. R., in *The Psychoanalytic Study of the Child*, **8**, 199-251 (Eissler, R. S., Ed., International Universities Press, Inc., New York, N. Y., 412 pp., 1953)
29. Eldred, S. H., Hamburg, D. A., Inwood, E. R., Salzman, L., Meyersburg, H. A., and Goodrich, G., *Psychiatry*, **17**, 337-46 (1954)
30. Erikson, E. H., *The Problem of Identity* (Presented at Mid-Winter Meetings Am. Psychoanal. Assoc., New York, N. Y., 67 pp., 1953)
31. Eysenck, H. J., *J. Abnormal Social Psychol.*, **50**, 147-48 (1955)
32. Foulkes, S. H., *Intern. J. Psycho-Anal.*, **35**, 263-66 (1954)
33. Freedman, M. B., and Sweet, B. S., *Intern. J. Group Psychother.*, **4**, 355-68 (1954)
34. Freud, A., *J. Am. Psychoanal. Assoc.*, **2**, 607-20 (1954)
35. Fromm-Reichmann, F., *J. Am. Psychoanal. Assoc.*, **3**, 5-6, 82-88 (1955)
36. Fromm-Reichmann, F., *Am. J. Psychiat.*, **111**, 410-19 (1954)
37. Fromm-Reichmann, F., *J. Am. Psychoanal. Assoc.*, **2**, 711-21 (1954)

38. Gallagher, J. J., *J. Consulting Psychol.*, **18**, 409-13 (1954)
39. Gibby, R. G., Stotsky, B. A., Hiler, E. W., and Miller, D. R., *J. Consulting Psychol.*, **18**, 185-91 (1954)
40. Gill, M., *J. Am. Psychoanal. Assoc.*, **2**, 771-97 (1954)
41. Gill, M., Newman, R., and Redlich, F. C., *The Initial Interview in Psychiatric Practice* (International Universities Press, Inc., New York, N. Y., 423 pp., 1954)
42. Gitelson, M., *Intern. J. Psycho-Anal.*, **25**, 174-83 (1954)
43. Goldfarb, A. I., and Sheps, J., *Psychosomat. Med.*, **16**, 209-19 (1954)
44. Goldman-Eisler, F., *J. Mental Sci.*, **98**, 660-70 (1952)
45. Goldman-Eisler, F., *J. Mental Sci.*, **100**, 177-97 (1954)
46. Gordon, T., and Cartwright, D. S., in *Psychotherapy and Personality Change*, 167-95 (Rogers, C. R., and Dymond, R. F., Eds., University of Chicago Press, Chicago, Ill., 447 pp., 1954)
47. Greenacre, P., *J. Am. Psychoanal. Assoc.*, **2**, 671-84 (1954)
48. Grotjahn, M., *Intern. J. Psycho-Anal.*, **25**, 254-62 (1954)
49. Grotjahn, M., *Psychiatry*, **18**, 9-15 (1955)
50. Hargrove, E. A., Bennett, A. E., and Steele, M., *Am. J. Psychiat.*, **110**, 844-48 (1954)
51. Harris, A., *J. Mental Sci.*, **100**, 718-21 (1954)
52. Heimann, P., *Intern. J. Psycho-Anal.*, **25**, 163-68 (1954)
53. Hulse, W. C., *Intern. J. Group Psychother.*, **5**, 45-53 (1955)
54. Kahn, S. W., and Prestwood, A. R., *Psychiatry*, **17**, 177-86 (1954)
55. Katan, M., *Intern. J. Psycho-Anal.*, **35**, 119-28 (1954)
56. Katzenstein, A., *Intern. J. Group Psychother.*, **4**, 409-18 (1954)
57. Knight, R. P., in *Psychoanalytic Psychiatry and Psychology*, 7-26 (Knight, R. P., and Friedman, C. B., Eds., International Universities Press, Inc., New York, N. Y., 391 pp., 1954)
58. Lacey, J. I., *Psychosomat. Med.*, **15**, 8-21 (1953)
59. Leary, T., and Coffey, H. S., *Psychodrama and Group Psychother. Monographs*, **28**, 47 pp. (1955)
60. Lipkin, S., *Psychol. Monographs*, **68**, 30 pp. (1954)
61. Miller, J. G., *Bull. Menninger Clin.*, **18**, 130-37 (1954)
62. Murray, E. J., Auld, F., and White, A. M., *J. Consulting Psychol.*, **18**, 349-53 (1954)
63. Murray, H. A., *J. Abnormal Social Psychol.*, **35**, 150-75 (1940)
64. Myers, J. K., and Auld, F., *J. Clin. Psychol.*, **11**, 51-54 (1955)
65. Nielsen, N., *Intern. J. Psycho-Anal.*, **25**, 247-49 (1954)
66. Nunnally, J. C., *J. Abnormal Social Psychol.*, **50**, 87-92 (1955)
67. O'Neil, W. M., and Levinson, D. J., *J. Personality*, **22**, 449-63 (1954)
68. Orr, D. W., *J. Am. Psychoanal. Assoc.*, **2**, 621-70 (1954)
69. Osgood, C. E., and Luria, Z., *J. Abnormal Social Psychol.*, **49**, 579-91 (1954)
70. Parloff, M. B., Kelman, H. C., and Frank, J. D., *Am. J. Psychiat.*, **110**, 343-51 (1954)
71. Pearl, D., *J. Abnormal Social Psychol.*, **50**, 227-29 (1955)
72. Phillips, E. L., and Johnson, M. S. H., *Psychiatry*, **17**, 267-75 (1954)
73. Rangell, L., *J. Amer. Psychoanal. Assoc.*, **2**, 734-44 (1954)
74. Redlich, F. C., Hollingshead, A. B., and Bellis, E., *Am. J. Orthopsychiat.*, **25**, 60-70 (1954)
75. Robinson, H. A., Redlich, F. C., and Myers, J. K., *Am. J. Orthopsychiat.*, **24**, 307-16 (1954)

76. Rogers, C. R., and Dymond, R. F., Eds., *Psychotherapy and Personality Change* (University of Chicago Press, Chicago, Ill., 447 pp., 1955)
77. Rosen, E., *J. Clin. Psychol.*, **10**, 345-50 (1954)
78. Rosen, J., *Direct Analysis: Selected Papers* (Grune & Stratton, Inc., New York, N. Y., 192 pp., 1953)
79. Rosenberg, S., *J. Clin. Psychol.*, **10**, 341-45 (1954)
80. Rosenthal, D., Frank, J. D., and Nash, E. H., *Psychiatry*, **17**, 215-24 (1954)
81. Rosenzweig, S., *J. Abnormal Social Psychol.*, **50**, 148 (1955)
82. Sacks, J. M., and Berger, S., *J. Consulting Psychol.*, **18**, 297-302 (1954)
83. Saslow, G., Goodrich, D. W., and Stein, M., *J. Mental Sci.* (In press)
84. Schofield, W., *J. Clin. Psychol.*, **10**, 203-12 (1954)
85. Schwing, G., *A Way to the Soul of the Mentally Ill* (International Universities Press, Inc., New York, N. Y., 158 pp., 1954)
86. Searles, H. F., *J. Am. Psychoanal. Assoc.*, **3**, 19-65 (1955)
87. Shagass, C., and Malmo, R. M., *Psychosomat. Med.*, **16**, 295-314 (1954)
88. Shugart, G., and Loomis, E. A., *Group Psychother.*, **7**, 118-24 (1954)
89. Singer, J. L., and Goldman, G. D., *J. Social Psychol.*, **40**, 23-37 (1954)
90. Singer, J. L., review of Bach, G. R., "Intensive Group Psychotherapy," *J. Abnormal Social Psychol.*, **50**, 153-54 (1955)
91. Slavson, S. R., *Intern. J. Group Psychother.*, **5**, 3-30 (1955)
92. Sommer, G. R., Mazo, B., and Lehner, G. F. J., *J. Clin. Psychol.*, **11**, 132-36 (1955)
93. Soskin, W. F., *Some Aspects of Communication and Interpretation in Psychotherapy* (Presented at meeting Am. Psychol. Assoc., Cleveland, Ohio, September, 1953)
94. Spiegel, J. P., *Psychiatry*, **17**, 369-76 (1954)
95. Stokvis, B., *Am. J. Psychother.*, **8**, 265-75 (1954)
96. Stone, A. R., Parloff, M. B., and Frank, J. D., *Intern. J. Group Psychother.*, **4**, 274-84 (1954)
97. Stone, L., *Intern. J. Psycho-Anal.*, **35**, 30-56 (1954)
98. Stone, L., *J. Am. Psychoanal. Assoc.*, **2**, 567-94 (1954)
99. Stone, L., *J. Am. Psychoanal. Assoc.*, **3**, 126-48 (1955)
100. Strupp, H. H., *J. Consulting Psychol.*, **19**, 97-102 (1955)
101. Sullivan, H. S., *The Interpersonal Theory of Psychiatry* (W. W. Norton, & Co., Inc., New York, N. Y., 393 pp., 1953)
102. Sullivan, H. S., *The Psychiatric Interview* (W. W. Norton & Co., Inc., New York, N. Y., 246 pp., 1954)
103. Szalita-Bemow, A. B., *J. Am. Psychoanal. Assoc.*, **3**, 7-18 (1954)
104. Szurek, S. A., *J. Nervous Mental Diseases*, **120**, 369-78 (1954)
105. Talland, G. A., and Clark, D. H., *J. Clin. Psychol.*, **10**, 131-37 (1954)
106. Thigpen, C. H., and Cleckley, H., *J. Abnormal Social Psychol.*, **49**, 135-51 (1954)
107. Tougas, R. R., in *Psychotherapy and Personality Change*, 196-214 (Rogers, C. R., and Dymond, R. F., Eds., University of Chicago Press, Chicago, Ill., 447 pp., 1954)
108. Weigert, E., *J. Am. Psychoanal. Assoc.*, **2**, 702-10 (1954)
109. Weigert, E., *Intern. J. Psycho-Anal.*, **135**, 242-46 (1954)
110. Whitehorn, J. C., and Betz, B. J., *Am. J. Psychiat.*, **110**, 321-31 (1954)
111. Winder, A. E., and Hersko, M., *J. Clin. Psychol.*, **11**, 77-79 (1955)
112. Wolberg, L. R., *The Technique of Psychotherapy* (Grune & Stratton, Inc., New York, N. Y., 869 pp., 1954)
113. Wolff, W., *Am. J. Psychother.*, **8**, 446-86 (1954)

## COUNSELING<sup>1</sup>

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When a longer historical perspective is available, it may well appear that counseling psychology as a recognizable specialty of genuinely professional proportions began with the Northwestern Conference of 1951. In the reports on general training standards (3) and on practicum training (4) issuing from that meeting, the Division of Counseling and Guidance of the American Psychological Association essentially accepted the distinction recommended by the earlier Ann Arbor Conference (96) between "counseling psychologists" as doctorally trained professionals and "psychological counselors" as subdoctorally trained technicians, went clearly on record as holding that professional service must "remain firmly established within the orbit of basic psychological science" (3, p. 176), and determined the fundamental outlines of the new profession's objectives and its basic training requirements both as a branch of psychological science and as a form of psychological service. Since then, as Super (90) has pointed out, the Division has significantly changed its name to the Division of Counseling Psychology, 18 doctoral training programs have been accredited by the American Psychological Association (6), the American Board of Examiners in Professional Psychology has modified its standards for certification in the light of this professional growth (1), there is a keen awareness of ethical issues (81), and the field is represented by its own professional and scientific journal, the *Journal of Counseling Psychology*, which began publication in 1954.

While time may call to question the details of this historical sketch, it seems obvious that counseling psychology has come of age with great rapidity. Like other segments of psychological science, this development from the sheer pursuit of behavioral knowledge to a specialized type of professional service has not been unattended by growing pains. Two of these developmental pangs are particularly noteworthy and received particular attention during the past year. One has to do with the problems that arise when the extension of broadly conceived professional functions leads to jurisdictional questions with other professional groups. The other is concerned with a kind of professional self-searching, an attempt to understand the motives and attributes basic to one's professional task.

This latter issue seems to arise from two sources. One, almost peculiar to psychology, is the strain associated with attempts to reconcile and harmonize the older traditions of psychology as science with the immediate and practical demands of psychology as service. It must be remembered that professional psychology did not arise, like medicine, as a separate discipline,

<sup>1</sup> The survey of the literature pertaining to this review was completed in April, 1955.

drawing on basic sciences, but as an outgrowth of a basic science itself in response to social need. This difference creates problems that may be quite special to applied psychology and for which few models in older profession-science relationships may be available. The other instigator of this kind of self-examination appears to be the often harrowing responsibility of direct work with people who are either poignantly troubled or who are seeking help in making such basic decisions as those affecting career choice, marriage, or considerable investments of time and money in educational ventures. Under such conditions, it is no wonder that the counseling psychologist finds himself concerned with such troublesome questions as these: What skills or knowledge do I have that enable me to help my clients? What can I do in these situations that other psychologists cannot? What personal characteristics does my job demand? When am I behaving in accordance with relevant observation and wise professional principles (whatever they may be), and when am I responding to personal need or in terms of some implicit or explicit bias about the professional issue at stake? How do I know how well I am serving my clients?

#### PROFESSIONAL DEVELOPMENTS AND PROBLEMS

Of the jurisdictional issues arising from professional expansion, the most central has been that involving relationships between psychology and medicine, especially psychiatry. Bound up as it is with such matters as legislation on licensing and certification, this matter has been of growing importance to counseling psychology since it was reviewed in 1953 (2, 19, 34, 47, 58, 98). During the past year, John Darley chaired a committee of psychologists who met with a comparable group from the American Psychiatric Association.

The most tangible outcome of this interchange was a debated proposal for a mutual moratorium on legislative efforts by the two professions concerned. Unacted upon at the time of this writing, the moratorium recommendation threatened to obscure three perhaps more fundamental implications of the meetings of these two committees. First, these meetings marked the first time that professional psychology and psychiatry had seriously come together to discuss as essential equals the pattern of their evolving relationships. From the reports available (79, 80), it would appear that these contacts were healthily educative for both sides and that the continuance of these discussions might well be instrumental in bringing some greater degree of understanding and vision into what have heretofore been bitter legislative battles. On the one hand, psychology has been struggling for favorable licensing or certification laws against medical opposition, usually in the active form of attempts to revise medical practices acts in such a way as to restrict the scope and independence of professional psychologists. The danger has been that the public might well be forgotten despite the fact that the final allegiance of the two professions is to the public

and that laws are written in the interest of public welfare, not professional advantage.

While this danger has not been obviated, it would appear that this committee work has helped to create a proper perspective by placing the problem in the context of general social control. One implication of the moratorium proposal was that the final decision with respect to formal legislation and informal professional status rests with the public and that, therefore, a program of honest public education should rightfully precede legislative attempts. Otherwise, the issue risks degenerating into the politics of vested interests. While applied psychology can hardly afford to relax its legislative vigilance or to abrogate its considerable professional gains, there seems to be a growing awareness that further advancements are more likely to come through a greater and more articulate concern for internal policing of professional practice, raising standards, and explaining psychological science and psychological services to the public at large than through interprofessional collisions.

Third, the reports of Darley's committee suggest that affairs between psychology and psychiatry have reached a state of stalemate. There seems to be a widely shared feeling that while professional psychology, especially in such key urban states as New York and California, has less of a chance of winning favorable legislation than it had two or three years ago, medicine also has a less favorable climate for the passage of laws restricting the functioning of psychologists. If this situation is correctly read, it may mean that a new development in interprofessional relationships may be in the offing with more emphasis on public education and the elevation of standards of training and practice, less on legislative agitation and direct forms of political struggles for power. Such a development would mark a new maturity in the handling of interprofessional relationships and may well lead to a wiser and a more responsible concern for making psychology's contributions to knowledge and to human weal more intelligible to a wider audience.

A rather different kind of jurisdictional issue arose during the past year, however, in counseling psychology's relationship to social work. No legislative problem is involved, but the case is one which provides a kind of rough sociological laboratory in which one can observe two professions coping with the potential conflict inherent in situations when the maintenance of prestige and a genuine regard for one's clientele may demand incompatible responses.

The function in point is that of the rehabilitation of the handicapped. The recognition of this type of service as an appropriate aspect of counseling psychology represents, perhaps, the most important professional development during the year. Because of the imperative social need to assist the physically and mentally handicapped to improve their employability and their general adjustment to the community, a considerable grant was made by the federal government to state Offices of Vocational Rehabilitation (66)



concurrent with the establishment of a counseling psychology program in the Vocational Rehabilitation and Education section of the Veterans Administration, where problems of the handicapped are of considerable concern. Since both of these projects emphasize training in order to provide a proper corps of service personnel, a great deal of thought has gone into the determination of standards, the domains of responsibility of the various helping disciplines (physical medicine, social work, occupational therapy, etc.), the specific contribution of counseling psychology to the total rehabilitation process, and the implications for the field of this extension of responsible interest.

Hamilton (45), writing as a social worker, essentially defined the rehabilitation counselor's job as officially described by the National Rehabilitation Association in 1950. He characterized the role of the rehabilitation counselor as that of helping the handicapped client to set his own realistic goals and to utilize the services and community resources which might facilitate their attainment and of helping to develop the rehabilitative process. This definition implies the maintenance of an ongoing relationship with the client, based on such skills as therapeutic interviewing, an understanding of human personality dynamics, the ability to evaluate human attributes, and knowledge of occupational information and placement procedures as well as of relevant medical information and community resources.

As Gustad (42) indicates, this definition strikingly resembles Hahn & MacLean's (44) description of the work of the general clinical counselor, who serves as a kind of coordinator of services, keeping in close touch with resources in the client's environment while providing him with a stable and helpful relationship as an aid to working through his objectives in a considered fashion. That counseling psychology has a potential and creative role in rehabilitation, therefore, seems clear. Fletcher (38) suggests that it is in the integration of services, in training, and in basic research into the dynamics of the handicapped and the evaluation of rehabilitative procedures that this role will most usefully take form. The actual outcome of this professional expansion of counseling psychology, however, awaits the solution of many problems in establishing training curricula (43) and in developing effective relationships with social work (42), which has a strong claim on the field.

This problem of laying claim to a new area of professional service while keeping in proper focus the needs of the relevant clientele shades into the problems of professional self-examination, which also received much attention during the year just past. For example, Wyatt (101) argued that the ubiquitous difficulty of fusing the values of psychology as science with those of psychology as service must be considered in the context of the socially engendered motives of the "new professionals" in the applied fields. He held that students in clinical and counseling psychology are under powerful

pressures to complete their training in order to secure positions which are both remunerative and status conferring. This kind of motivation may be somewhat at variance with that demanded to master a science, and this different motivational frame of reference may account for some of the fissionable character of current psychology. Such internship arrangements as those in the Veterans Administration, for instance, amount to the trainee's "being paid for applying in the afternoon what he has learned in the morning." This state of affairs puts a premium on sheer practicality and on the skills and information that have current market value and facilitates professional identifications, as Shaffer (82) suggested, with field workers who appear "to get results" rather than with those primarily concerned with scholarship, theoretical advancements, and research of a "pure" kind.

How to fuse these traditions of practical clinical sensitivity and scientific rigor remains a pressing issue. Solomon (87) stated the conflict representatively by calling attention to "The Paradox of the Experimental Clinician," who attempts to unify an experimental training that demands rigid controls and precise manipulation of variables with a clinical training that demands flexibility in following client leads, the exercise of "intuition," and the utilization of gross and qualitative insights. Kahn (52) attempted to resolve this dilemma by the reminder that "truth has many faces," and by taking the position that the approach of the clinician is different from but not in genuine conflict with that of the experimentalist. His basic contention is that observations of relevance for the counselor, like test responses, serve not so much as samples of behavior as symbols for it. Symbols exist in a different dimension from what is symbolized but have "identity" with it, and through the comprehension of these symbols as a result of clinical experience and psychodynamic knowledge, counselors arrive at "valid pictures."

It is unlikely that this resolution will find much favor. Symbol or sample, test responses or other observables in the counseling situation must still be related to specified criteria in some way, and whether the methods of the counselor or those of the experimentalist and statistician are superior is still to be determined. It seems significant that both Solomon's and Kahn's papers were written after the publication of the Pepinskys' book (70), in which a strong case was made for the relevance and utility of scientific training and sophistication for clinical practice.

Kelly (54), considering these tensions connected with the blending of scientific investigation and professional service, simply held that this discomfort reflects the plight of psychology generally. "Psychologists have yet to learn how to test in the laboratory the induced hypotheses of the therapy room. And our discipline has yet to build a theoretical framework that will deductively support both clinical insight and experimental inquiry" (54, p. 173). This argument places the issue where it would seem to belong—in the realm of substantive knowledge. The question is at bottom one of the nature of clinical procedures and of what they add, if anything, to experi-

mental and statistical attacks on behavioral problems. Fortunately, psychology in general and counseling psychology in particular have begun to turn some of their research efforts toward the examination of these professional issues.

#### STUDIES OF THE COUNSELOR

To be clear about the question of what the clinical process may contribute, one must understand that it can be considered in at least two very different broad frames of reference. On the one hand, the counselor's job may be studied from the standpoint of its accomplishments, what it does for the benefit of the counselee or what changes in client behavior are associated with it. This angle of regard is essentially the therapeutic one, and its focus is on client outcomes. On the other hand, the clinical interaction may be examined in terms of its contribution to knowledge about client behavior, what it adds to a predictive understanding of how a person will behave under specified conditions. This concern is substantially the diagnostic one, and its essence is the prediction of such important things as success in a job, response to a particular form of treatment or training, marital happiness, better social adjustment as a result of various forms of group participation, and many others.

There is no implication here that the therapeutic and the diagnostic frames of reference are unrelated. Shoben (83) has suggested, for example, that much of the therapeutic process involves the implicit prediction that a given counselor response will have a specified effect on the client's behavior and therefore rests on some diagnostic hypothesis. It is important to recognize, however, that the therapeutic and diagnostic problems are different and that the questions of outcome and predictive knowledge can probably best be considered separately. This point gains in cogency when it is remembered that therapeutic skill is often confused with predictive accuracy and that signs of client benefit are sometimes quite inappropriately taken as indices of how much the counselor "knows" about his counselee.

Perhaps the most important publication of the year, Meehl's *Clinical vs. Statistical Prediction* (63), dealt with this issue of what the clinical process contributes to diagnostic efficiency in the predictive sense. Meehl first clarifies the problem by pointing out that in forecasting the behavior of a person, one has two alternatives. One may order the case to some class according to his life history data, his test scores, or such other sources as impressions formed from the interviews. Once the classification is made, some actuarial table may be entered which gives the frequencies of various behaviors for persons belonging to the class. The emphasis is normative and empirically statistical. On the other hand, one may organize much the same kind of data into some psychological hypothesis, implicit or explicit, about the structure and dynamics of the particular individual. From this hypothesis, a prediction can be deduced. The emphasis here is on the configuration

of the particular person, not on empirically derived probabilities for classes of persons.

To test which of these seemingly different methods of prediction is better, the same basic set of facts must be subjected to (a) analysis by a trained clinician and (b) such mechanical operations as can be performed by a statistical clerk. The resulting predictions can then be compared in terms of their success. In spite of the importance of this issue, Meehl reports that there were virtually no carefully executed studies of the problem prior to 1950, but he discusses 20 investigations (a surprisingly small number!) that bear on it more or less directly. In all but one of these studies, predictions made by the statistical method were either equal or superior to those made by a clinician.

Since the publication of Meehl's little book, Holtzman & Sells (49) have shown that outstanding clinicians, working from biographical data and five test protocols similar to those usually taken in clinical practice, were unable (with pilot aptitude constant) to predict those who successfully passed flight training as against those who were eliminated from it for neuropsychiatric reasons. This negative finding holds both for global evaluations of the data and for predictions made from individual tests. Two of the tests and the biographical inventory, however, have predictive validity of the statistical sort. These results, so reminiscent of those of Kelly & Fiske (53) in the Michigan assessment program, are quite consistent with those reviewed and analyzed by Meehl.

Holtzman & Sells, however, report another finding of considerable suggestiveness. In spite of their common inability to predict successfully, the clinicians in their study agreed to a marked degree among themselves! In other words, the predictive errors were widely shared.

It is at this point that Meehl's excellent logical analysis of the clinical process and McArthur's (62) stimulating paper on the same topic become particularly important. Both of these writers are quite explicit in acknowledging instances of clinical virtuosity and underscoring the fact that clinicians appear to distribute themselves along a range of predictive ability. Meehl argues that this ability may be relevant for certain problems but not for others. When the behavioral alternatives to be predicted are small in number and highly specific, and when the predictor data define a class of persons for which relative frequencies can be determined, then actuarial methods are probably superior. Such methods simply follow the rules of probability without requiring the mediation of some hypothesis which dynamically relates what is known about the person to what he is likely to do.

But consider the case of the failing college student with high academic ability who says during an interview, "I had a nightmare last night. Some big monster wanted me to jump over hurdles he had set up. When I couldn't, he died of apoplexy or something. I was sure scared, but I was glad when he died." The counselor replies, "Your not doing well at college is pretty up-

setting to your father, isn't it? And you're not entirely displeased to see him disturbed." Later developments confirm this counselor impression.

The point at issue is neither the therapeutic helpfulness of this counselor response nor the general utility of any theory it implies. Rather, as Meehl points out, this brief interchange points up the difference in clinical as opposed to statistical predictions. The hunch that the dream symbols represented hostility toward the father expressed through academic failure involved a creative act by the counselor with which the actuary and the logician have no concern and which is not given by any kind of probability table. The clinician has had to hit upon what is to be predicted and to formulate an hypothesis which relates his observations to his tentatively chosen criterion.

The crucial problem then becomes, as Meehl (64) elsewhere states it, "For what *classes* of predictive problems is the success frequency generated by entering the  $\text{fact}_1$ -hypothesis- $\text{fact}_2$  sequence superior to that generated by going through the straightforward, actuarial  $\text{fact}_1$ - $\text{fact}_2$  sequence?" No one knows the answer, although Meehl's book suggests a number of cases where the intermediary step of hypothesis-formation seems to be of doubtful power, but there are few research topics more in need of attention. Meanwhile, there are three broad problem areas defined by a concern for this diagnostic issue.

First, there is the question of how the counselor arrives at his mediating hypotheses. McArthur argues that the least successful clinical predictors tend to apply systematically rules derived from previous cases or to use existing psychological theories in a rather doctrinaire fashion. The most successful predictors, on the other hand, appear to proceed much more inductively, developing the very categories into which the facts are finally cast on an inductive basis from the data themselves. Koester (55), in the one study of diagnostic insight that seems genuinely relevant, had counselors "think out loud" before a microphone while they read case materials and made diagnoses. He found that diagnostic understanding emerged slowly rather than suddenly and seemed to proceed in an orderly way through examination of the available data, interpretation of various data, formulation of hypotheses from various combinations of data, and the evaluation of these hypotheses in the light of all the data available. Koester's counselors, whatever their theoretical preferences, seemed to proceed in an essentially eclectic manner, searching for the interpretation of any given datum that would yield the greatest congruence with all other data and with the hypotheses already tentatively formulated. Although the validity of these diagnoses was not appraised against any criterion, Koester implies that his counselors performed least well when they adopted a particular "set" toward any given case, attempting to fit the person onto the Procrustean bed of some particular theory. A corollary finding was that counselors differed in their willingness to seek negative evidence to refute their own trial hypotheses, the implication again being that the effectiveness of diagnostic under-

standing (predictive efficiency) is related to this kind of searching for the best mediating hypothesis. McArthur's suggestion that diagnostic understanding may be understood as a special case of problem solving and Koester's ingenious study should point the way to a good deal of creative and fruitful research on the counseling process.

Second, no matter how eclectic the counselor's manner of approach to a diagnostic judgment, it seems inevitable that he make use of some theory. Indeed, "clinical intuition" seems to represent in part this kind of utilization of theory when it has been sufficiently well practiced to occur with great rapidity. Certainly, one rarely encounters "intuitive" behavior of this kind in counselors without considerable training and experience. If this point holds in any significant degree, and if one recalls the finding of Holtzman & Sells that clinicians were consistently wrong in their predictions but that they agreed remarkably well among themselves in their errors, then one can hardly escape the suspicion that something must be amiss in available theories typically employed by clinicians. Even though the situation may have been one where actuarial methods were more appropriate, the agreement in errors hints at some common stereotypes among counselors, rather than at useful theoretical constructs. While the problem appears to have gone unconsidered during this past year, it seems possible that counseling psychology has attacked its problems piecemeal, amassing a great number of empirical results and testing (a bit inconclusively) a number of minor hypotheses with little regard for integrative concepts or rigorous but overarching theoretical formulations. This kind of sweeping conceptual performance is neither easy nor can it be produced on demand, but one may legitimately wonder during an annual stock taking why there has been so little concern for integrative theory building in terms of its diagnostic fruitfulness. One guess is that the *Zeitgeist* is such that the rewards are both higher and more easily won for the publication of minor research studies and programmatic pieces than for the development of difficult and testable theoretical ideas of large import. Another is that the atmosphere of professional practicality in counseling psychology and applied psychology generally discourages this kind of contemplative effort when it must compete with the immediacies of service obligations and when prestige among one's colleagues is more easily come by through attention to more superficial but pressing practical problems. A third speculation is that the American culture generally is one that builds up a greater respect for the engineer and the technician than for the theorist (18). Further guesses would probably be gratuitous, but again, a need and a challenge arise from a consideration of this issue.

Finally, the problem of diagnostic understanding shades into that of the general ability to judge people. Taft (92), reviewing 81 studies, concluded that age (in children but not in adults), high intelligence and academic ability, specialization in the physical sciences, esthetic and dramatic interests, insight into one's status among one's peers on specific traits, good emo-

tional adjustment, and social skills are related positively to the ability to judge others. On the other hand, social dependence and "psychasthenia" score on the Minnesota Multiphasic Personality Inventory seem to be negatively related. A consistent lack of correlation appears between judging ability and age (in adults), sex, and training in psychology! Possible relationships on which the evidence is inconclusive include a negative correlation with number of older siblings, a positive  $r$  with literary ability, and a negative correlation with being a clinical psychologist.

Such findings again force one to face the question of whether professional understanding in psychology is an inarticulate but useful outgrowth of counseling experience, the result of systematized knowledge that is genuinely and generally productive of valid mediating hypotheses, or a partly self-deluding congeries of stereotypes about people that actually interfere with effective interpersonal judgment. Once more the distinction between the diagnostic and the therapeutic frames of reference seems in point. Meehl (63) points out that in the treatment process, a good bit of time can be spent without waste or disregard to the client's welfare in exploring erroneous hypotheses about his behavior. It is even conceivable that this following of wrong leads is beneficial in that it stimulates the client to think about himself in helpful ways. In the context of judging personal attributes or of predictive diagnosis, however, a bad hypothesis merely lowers the success frequency. Since there is a strong possibility that these two functions may be related, it is especially important to consider the actual extent to which counselors accurately or inaccurately judge others and the factors which determine their errors.

In the last year there were few research attacks on this problem, but those that were published were suggestive if only because of their indication of the chaotic state of this field of inquiry. One central issue, of course, has to do with the amount of information necessary for accurate clinical judgment. Another is concerned with the relationship of experience to judgment. Bendig (10), using undergraduate and graduate students in psychology as raters, found that interjudge reliability was a positive function of the length of the case history abstracts on the basis of which the ratings were made. Bendig (10) and Bendig & Sprague (11) also found that the less experienced raters were more variable in their judgments than were the more experienced ones. On the other hand, Arnhoff (7), studying the ratings of undergraduates, clinical internes in psychology, and professional clinicians, found that interjudge agreement decreased as a function of training and experience. Similarly, Levin (59) found no increase in inter-rater reliability with an increase in amount of interview material available. These papers are not strictly comparable in that they involved different kinds of stimulus materials, and they miss the point in investigating interjudge reliability rather than judgmental accuracy or validity. Nevertheless, their contradictory results call attention to an area of professional functioning that requires further and



more definitive exploration. While the criterion problem is difficult (51) and validity is a much more slippery and elusive thing than interjudge agreement, such issues cannot be begged if counseling psychology is to advance.

A third variable in the judgment process is that of the type of information available. Korner & Westwood (56) had three clinicians rate the figure drawings and group Rorschachs of 96 college students according to three levels of general adustment. Correlations among the judges were .59, .68, and .68 for the figure drawings; for the Rorschachs, they were .09, .41, and .44. The correlations between ratings based on Rorschach and those based on figure drawings were .20, .27, and .35. While all but one of these relationships are statistically stable, it should be noted that, at best, nearly two-thirds of the variance in one rater's judgment is unaccounted for by the variance in another's, and the very low correlations between judgments made from the two different instruments leaves a more important question to be answered than the one originally tackled: What differences in either actual information or clinical interpretations are involved in these readings of two widely used tests? Again, the crucial issue of validity of judgment is untouched.

A beginning clarification of these three issues was established in a series of related studies by Hamlin (46), Bialick & Hamlin (13), Cummings (25), and Newton (68). Working from Rorschach protocols, these investigators concerned themselves with the problem of what unit is most conducive to valid clinical judgments. They uncovered evidence supporting the proposition that both small, mechanically scored units, such as individual test signs, and such global units as the entire test record are likely to lead to negative judgmental results, whereas the probability of positive results is increased by the use of samples of behavior just complex enough to represent some degree of organization and to demand some rational interpretation rather than a score without a rationale.

Meanwhile, the question remains of the source of individual differences in diagnostic judgment among counselors. Robinson & Cohen (72), developing a line of investigation represented by earlier studies of individual bias in evaluating the personalities of patients, studied the case reports of internes in clinical psychology and found "pronounced and reliable differences," which they interpreted as related to the personality characteristics of the internes. This study makes an interesting foil for the somewhat different one by Garfield, Heine & Leventhal (40), who had the case reports by psychologists in a Mental Hygiene Clinic evaluated by psychiatrists, social workers, and psychologists themselves. They found frequent criticisms on the ground that the reports were too speculative and too vague, omitted supporting data, lacked behavioral referents for general statements, and relied too heavily on professional jargon. Such results bring to mind Davenport's (26) investigation, which showed that clinicians tend to describe clients in terms that are vague (in the sense of having no precise behavioral referent) and universal (in the sense of being applicable to very large num-

bers of people) and that they tend to avoid terms which are precise and particular. From these considerations, one is forced to the somewhat nihilistic hypothesis that counselor judgments may differ as a function of personality differences among the clinicians but derive some commonality from this tendency toward vagueness and universality in the clinical language. Obviously, this kind of contention has more weight as the predictions demanded of counselors become more specific. As Robins & Mensh (71) put it in their study of behavioral predictions from physiological antecedents, psychologists are much more successful in predicting confusional psychosis from low blood sugar than they are in predicting the precise behavior of the patient while confused because of lowered blood sugar. Nevertheless, this rather discouraging inference must be dealt with directly; its disproof lies not in argument but in effectively done research and its appropriate professional translation into trainable clinical skills or the selection of trainees with the most appropriate personal attributes.

On this last point of counselor trainee selection, there is a good deal of dissatisfaction and great variability in procedure (5), together with at least two discouraging precedents (48, 53). The start of a serious effort to study the differentiating characteristics of successful counselors, however, has been made by Cottle and his co-workers (20 to 24). Concerned essentially with the dimension of personal attitudes, these investigators have developed an Experimental Attitude Scale from the Minnesota Multiphasic Personality Inventory and the Guilford-Zimmerman Temperament Scale which shows promise and has reached the stage of further refinement through longitudinal studies of counselors in training. Good discriminations have been obtained between male counselors and male classroom teachers, for example, and patient and collaborative effort may produce an instrument that will help much in discovering the attributes fundamental to successful professional activity in counseling psychology.

Snyder (86) has similarly examined the characteristics of "good" and "poor" students in clinical psychology, finding that the good trainees are more aggressive, independent, unconventional, intellectual, and gregarious, and less religious, neurotic, and prone to inferiority feelings. The degree of overlap between the two groups on these traits was considerable, however, and much more work remains to be accomplished before the basic attributes of clinically able people can be readily identified. Such an achievement would not only solve many practical problems of trainee selection but would benefit the public as much as the profession. As a substantive issue, it deserves far more attention.

#### THE COUNSELING PROCESS AND ITS OUTCOMES

When one turns to papers on the counseling process itself and its outcomes, one finds rather less vitality and novelty. The past year does not seem to have produced the same kind of conceptual or empirical ingenuity as rep-

resented previously by the Pepinskys' book or by the volumes edited by Mowrer (67) or by Rogers & Dymond (74). Perhaps the literature can best be considered under the headings of theoretical contributions, studies in the process of counseling, and investigations of counseling outcomes.

*Theoretical contributions.*—Probably the foremost theoretical item was Bordin's (14) introduction of the ambiguity-structuredness variable into considerations of the counseling process. His central idea is that counselors may either deliberately or inadvertently structure the stimulus field, of which the therapist is himself a crucial part, for the client in various degrees. This degree of structuring may affect (a) the topics which it is appropriate to discuss in the counseling situation, (b) the closeness and character of the relationship, and (c) the goals toward which the counseling process is directed. Such a notion generates a number of hypotheses which are significant for counseling theory and practice and which should lead to significant research efforts.

For example, while ambiguous situations may be therapeutically fruitful because they elicit from clients those responses most intimately bound up with their own motivations and emotions and because they bring into sharpest focus the distortions of counselees, they are also likely to evoke anxiety. If an optimal level of anxiety is considered most productive of therapeutic progress for each patient, then the degree of ambiguity must be balanced against the degree of anxiety elicited. Second, if ambiguity indeed encourages the production of highly personal and affective reactions in the client, then one can hypothesize that the intensity of transference is a function of the extent and duration of the ambiguous aspects of the counseling relationship. Third, a meaningful differentiation between "counseling" and "psychotherapy" may be possible on the basis of the ambiguity dimension. Counseling relationships are those of lesser ambiguity and, consequently, a less intense relationship concerned with more limited and more highly specified topics. Finally, one would expect to find decreasing ambiguity as a function of client progress.

Many more important hypotheses could readily be generated, and Bordin has invested his ambiguity concept with two advantages. First, he has worked out ways of reliably rating degrees of ambiguity in counseling protocols, thus providing at least an ordinal measure of the dimension. Second, the notion, rather than being a conceptual outgrowth of a concern for the psychotherapeutic enterprise alone, has connections with more general psychological ideas. It is related, for instance, to the theory underlying projective techniques, the psychology of perception, and social psychology, where a similar concept has wide currency as "intolerance of ambiguity."

Conceivably, Bordin's ambiguity variable may be related to the dimension of objectivity-subjectivity as Oppenheimer (69) discusses it in a preliminary fashion. His main point is that in his relationship to his client, in his

emotional reactions to him, and in the consideration of values, the counselor must steer a middle course between becoming too involved with his patient either positively or negatively and regarding him as nothing more than a guinea pig. While warmly interested in their clients as people, counselors must consider in a dispassionate way opinions and attitudes which are often at variance with their own, responding to them as expressions of client personality to be worked with helpfully. One point at which this notion becomes particularly applicable is in coping with guilt feelings. A complete "objective" position from which the counselor makes no moral judgments risks the damaging acceptance of unjustified guilt instilled by narrow and warped socialization agents. On the other hand, a "subjective" approach risks making the client over in the image of the counselor's own values.

While Oppenheimer's paper is suggestive and has much to commend it, the objective-subjective dimension is not yet thought out in terms that permit a counselor to think about his own work in clarifying ways or that lead to empirical research. The problems he discusses, however, are realistic ones for any practitioner, and they must be dealt with eventually in a more operational language that still retains the clinical relevance that one perceives in this article.

In a less ambitious frame of reference, Thompson (93) sketched "a rationale for vocational guidance" in terms of three principles. First, vocational choice is a process rather than a single event, and counseling must take into account this ongoing character of career planning. Second, vocational decisions involve other than purely rational considerations, so counseling must concern itself with motives, values, and self-conceptions as well as with abilities and interests. Third, because of these considerations, vocational counseling must be concerned with the "total person" in the sense of helping to develop a mature individual equipped to relate himself effectively to the world of work.

Thompson is explicit in stating that his principles are related to the premise that in American society personal freedom of vocational choice is an inherent right. While this freedom to choose imposes a responsibility for one's choices, it also obligates society to provide assistance in making them. Super (91), in an unusual review of manpower policies in foreign nations, found that vocational guidance in underdeveloped countries and in societies with disturbed economies is regarded primarily as a way of obtaining the needed supply and distribution of manpower. In societies that are more favorably situated economically, on the other hand, vocational guidance is thought of as a way of helping individuals to develop their fullest potential and of assuring to the social order the free circulation of all possible talents. This clarification of the social and economic background out of which grow ideas about guidance and the counseling process and the values inherent in them is a significant contribution to an understanding of the profession. One hopes that more sociological studies of this sort will ensue.

*Process studies.*—Dressel (30), observing practices by professional counselors with a college student clientele, was forced to the conclusion that counselors frequently seem preoccupied with gathering information about the counselee to the exclusion of helping him to understand himself. The argument here is the familiar one that the counseling process is fundamentally aimed less at the solution of specific problems and more at facilitating the client's recognition and elimination of impediments to his solving his own difficulties.

While one can be grateful for Dressel's amusingly presented and helpful catalog of counselor errors that lead him to this statement, his central contention points in two directions. First, significant thought and research on the counseling process among "counseling psychologists" are in the main indistinguishable from such efforts on the part of "psychotherapists." While emphasizing positive and preventive rather than remedial functions, counseling psychology has essentially taken over a psychotherapeutic point of view, has recognized the necessity for genuine psychotherapeutic training among its representatives, and has begun to adapt psychotherapeutic ideas to its own research and service purposes. Dressel's remarks are a nice illustration of this trend.

Second, they lead to an important substantive issue by virtue of their collision with Bordin's (15) preliminary study of client expectations and their implications for the counseling process. He finds that many counselees approach counseling with a set to consider a particular decision. Such clients appear to assign little importance to the personal characteristics of the counselor and to feel less inclined to put a high value on the counseling relationship. On the other hand, clients who come to counseling with a perception of themselves as a source of their difficulties, even though these difficulties may involve primarily the making of some specific decision, are much more likely to put a premium on the personal attributes of the counselor. The implications of this observation are manifold, but they place particular stress upon the importance of initial contacts, the process of structuring, and the appraisal of the client's adequacy. Seeking help in decision making can be an act of strength as well as an admission of weakness, and the sensitive counselor will proceed differently depending on his recognition of this factor in his early contacts with his client. Conversely, client expectations must be modified when personal inadequacy seems at issue in counselees with a predominantly decision-making set. In such cases, the counselor and his client must establish the perception that it is the counselee himself and his personality which are the central objects of concern.

The procedures for accomplishing such change presumably vary from one therapeutic school of thought to another and with the degree of the counselor's experience. Fiedler's (37) studies have tended to emphasize the experience variable over that of allegiance to a particular school. Strupp (88) similarly found that experience is a predominantly influential determinant;

but in his analysis of the verbal responses of Rogerian and psychoanalytic counselors to patient statements in therapeutic protocols, he discovered wide differences in therapeutic technique attributable to theoretical viewpoint. Rogerians, for example, show a strong predilection for reflective responses with a concomitant lack of responses in other categories. Psychoanalytic therapists show a much more even spread of their responses over a variety of techniques. Nevertheless, Rogerians disclose a significant decline in reflective responses as a function of experience, and there is some evidence indicating that experience leads to a diversification of counseling techniques generally. Interestingly, Strupp finds that Rogerians who have been analyzed, like other counselors whose training has included a personal analysis, tend to use fewer silent responses and to utilize passive acceptance much less frequently than those who have not undergone therapeutic experience themselves.

Danskin & Robinson (25a), however, investigating the differences in "degree of lead" employed by a group of experienced counselors, found wide individual differences but no constellations predictable from the directive-nondirective dichotomy although the self-consciously nondirective counselors, for the most part, fell in the lower half of the distribution. Perhaps one of the most interesting outcomes of this study was the finding that counselors may vary their techniques somewhat from client to client but tend to maintain the same relative position on the scale of leading the counselee.

This suggestion of a personal "style" in counseling was further studied by Danskin (25b) in terms of rather narrowly conceived "roles" such as listening, supporting, informing, advising-tutoring, etc. Aside from the important finding that judges can agree both on the location of counselor roles in interview transcripts and on the type of role reflected by the counselor's behavior, this investigation is interesting because of its discovery that roles vary not only with the topic being discussed but with the counselor's preference, thus lending weight to the hypothesis of a personal style in therapeutic work. This problem deserves much more intensive exploration in terms of the character of counselor styles, their relationship to outcomes with particular kinds of clients, and their determinants and correlates in the previous experience and the personality structure of counselors.

It is quite conceivable that one aspect of therapeutic style may involve varying degrees of attention to the positive assets of the client. This factor has been called to attention by Witryol & Boly (99) in a thoughtful paper in which they discuss the advantages of clarifying in counseling the areas of adequate behavioral functioning for clients as well as the areas of disturbance. This shift away from the traditions of psychopathology and the historical stress of psychoanalysis on personality malfunctions represents one of the emerging contributions of counseling psychology to the entire psychotherapeutic enterprise.

It is possibly at this point that a word should be said about textbooks in counseling. The year produced four (8, 50, 78, 97), of which Sanderson's is perhaps the best and most useful in spite of its restriction to essentially vocational problems and its almost complete conceptual divorce from the main stream of psychological science. The most noteworthy thing about these books in their lack of attention to the counseling process generally. They devote much space to testing and to record-keeping but little more than a chapter to the actual face-to-face relationships within which the counselor centrally functions. Why this state of affairs should obtain is hard to say, but the fact that little more attention was given to the counseling process in the year's serious research output may provide a clue. What happens in counseling is difficult to understand in rigorous terms and difficult even to demonstrate short of extensive interview transcripts with commentary in the manner of Gill, Newman & Redlich's (41) fascinating volume. This sheer matter of difficulty may be a deterrent both to creative research effort and to the preparation of useful instructional materials. Yet this challenge is a fundamental one that must be met with imagination and industry if the applied sciences of man are to increase in the related fields of knowledge and service. And, as Dressel (29) points out, research in the counseling process must be planned with proper regard for the realities of the counseling situation if it is to have any beneficial impact upon professional practice.

*Outcome studies.*—A similar difficulty besets studies of counseling outcomes whenever degree of improvement is at issue, but here a great deal of stimulation has come from Eysenck's (36) suggestion that patients who do not receive psychotherapy improve as much as those who do. Eysenck's study has provoked a number of replies, notably those by Rosenzweig (76) and by De Charms, Levy & Wertheimer (27), but their argument that his data were inadequate in many ways says nothing that Eysenck himself did not say, and the conclusive evidence of therapeutic effectiveness must come not from argument but from relevant and rigorous research.

Dymond (32) made a start on this kind of investigative enterprise by studying the changes taking place in six applicants for counseling who decided after a waiting period that they did not need it. These six cases seemed to change as much in terms of self-descriptions as did those who went through therapy successfully. On the other hand, this increase in adjustment was not confirmed by Thematic Apperception Test ratings; and when the six were compared with successful therapy cases matched for initial status and degree of improvement on self-descriptions, it was found that the uncounseled cases appeared to have changed primarily in a strengthening of their neurotic defenses and a denial of their need for help. While this study is severely limited by its small *N* and the short time period involved, it defines lines of inquiry that are of first importance in outcome research.

A different approach to counseling outcomes is that of studying particular



effects of counseling rather than its over-all benefits. Froehlich & Moser (39), for instance, asked if clients remember test scores as a result of their interpretation by counselors. They found that a large proportion of counseled high school students do not accurately recall their reported scores on the Differential Aptitude Test battery. Accuracy of recall varied from test to test and with the intellectual brightness of the clients but not with percentile rank on the tests used. Rogers (75), assuming correspondence of self-ratings and test scores provides an index of self-understanding, conducted a similar study concerned with the differential effects of two kinds of counseling. One kind was designed to encourage client participation and client self-evaluation. The other was primarily test oriented. While both methods appeared to contribute to increased self-understanding, no stable difference in effectiveness emerged between them. Since one counselor tried to administer both forms of "treatment," however, Rogers's study raises the question of whether any given counselor can violate his "style" sufficiently to work in two clearly different counseling modes. Singer & Steffire (85), however, obtained similarly inconclusive results.

Ewing (35) turned to attitudinal changes associated with counseling and obtained pre- and postcounseling ratings by 39 clients of their "self," "ideal self," father, mother, and counselor. His findings are suggestive. Clients judged by their counselors to be most improved changed their ratings of self to be more like their ratings of ideal self and their ratings of the counselor. Likewise, their ratings of the counselor and of the parent of the same sex as the counselor become more similar. The implications for transference theory are striking, and one gets the impression that these changes reflect a considerable tendency for successfully counseled cases to regard themselves more like other people whom they respect and to form more realistic ideals for themselves.

While none of these studies has a definitive quality about it, they all represent courageous and honest efforts to attack the difficult problem of counseling outcomes. Calvin (16) underscored both the importance of such attempts and the obligation that they impose by pointing out that the answer to medical objections to therapy by psychologists lies in the experimental demonstration that psychological counseling is of benefit to clients. He might have added that one of the unique contributions of psychology to human understanding and human welfare is the identification of the therapeutic procedures that result in helpful client changes. He does, however, make it clear that research in this area must be rigorous, and his discussion of misuses of experimental method here is revealing and useful.

#### PSYCHOLOGICAL MEASUREMENT IN COUNSELING

Perhaps the event of most general usefulness in the measurement field was the publication of Thorndike & Hagen's (94) text. The notion of measurement as a tool, not an end in itself, is adhered to throughout this clear

volume, and the concentration on problems of substantive importance makes it a mine of incidental information as well as an indispensable handbook for counseling psychologists. A specific chapter on educational and vocational guidance is of particular importance. New approaches, guiding concepts, and immediate relevance for the practical and investigative problems in the field make this book much more than a text.

Among the new tests, the *Edwards Personal Preference Schedule* (33) requires special mention. Designed in terms of 15 of Murray's needs, the *Schedule* consists of 225 forced-choice items, each pair of alternatives matched for social desirability. As a result of this feature, the instrument avoids the difficulties arising from different social stereotyping of item alternatives and from socially determined ego-involvement. Internal consistency estimates of the need scales range from .60 to .87, and the retest reliabilities from .74 to .88. Scale intercorrelations are low. There are few questionnaires in the area of personality and motivation that possess so much potential value for both clinical and research use.

The third major item was probably Loevinger's (60) discussion of personality measurement. She begins by a consideration of the elements of structure and disguise in personality tests. With respect to structure, she points out that test responses can be considered from the standpoint of their meaning in terms of the individual or in terms of the group. The greater the degree of structure, the more exact can be comparisons between individuals and the group, but the less exact is the relation of the response to the trait in the individual. With respect to disguise, the clearer is the meaning of the test item to the trait to be measured, the more likely is a defensive or evasive response by the subject. These dilemmas are real ones; to the extent that one measurement characteristic in these two dimensions is refined, the other must become cruder.

From this demonstration, Loevinger proceeds to show that the only kind of test structure that can be dealt with statistically in a sophisticated and sound fashion is one with cumulative items scored dichotomously. In such tests, items that are disguised are low in homogeneity. On the other hand, direct items tend to be low in validity. To achieve tests of high validity with necessarily disguised items, the questions must be numerous and diversified. Thus, for items of nonzero validity, however small, the validity of a test can be increased to any magnitude by increasing the number of questions, provided the error in each item is uncorrelated with the error in every other item.

Having developed these points in detail and applied them to some current issues in personality assessment, Loevinger proposes a method of test construction based on low intercorrelations among a large pool of items. Since as few as five homogeneous items, none of them diagnostic in themselves, may comprise a fairly effective empirical definition of a trait or attitude, this searching for statistical relationships among items reflecting common psychological ideas permits one to develop new concepts as well as

to apply a metric to old ones. For example, where statistical coherence emerges in items whose manifest content is dissimilar, one is justified in postulating some underlying determining tendency or hypothetical construct. If these constructs approximate concepts in personality theory derived in other ways, an important independent line of verification is established. If the constructs are different from those in current usage, they may possess a new conceptual utility well beyond the sheer matter of measurement. All counseling psychologists will want to familiarize themselves with Loevinger's thinking here.

As one would expect, there were other important developments during the past year in measurement concepts and methods. DuBois, Teel & Petersen (31) described four methods of validating proficiency tests, a particularly important matter considering the growth of interest in rehabilitation among counseling psychologists, each method serving a somewhat different purpose but each relatively free of extraneous variance. The theoretical orientation provided in this article will be helpful to test users as well as to test constructors.

Windel (100) exhaustively considered the always worrisome problem of test-retest effects on personality questionnaires. He found that while the usual retest score tends slightly toward "better adjustment," the change is small. It must be taken into account, however, since when  $N$  is large, the difference can often attain statistical significance. Windel, recognizing that simple test-retest designs are inadequate for studies of change in adjustment, advocates the regular use of control groups. His treatment of the problem sheds light on many contradictory results obtained in investigations of client change in counseling or as a function of some presumably rehabilitative experience.

Torrance (95), also concerned with personality measurement, asked college freshmen to estimate their standing among their classmates on tests of general scholastic ability and achievement. While he found little relationship between self-estimate and achieved standing, he reports that clinical studies of the most serious mismeasurements revealed them to be troubled with "a sense of vulnerability." Since the securing of such self-evaluations is easy, quick, and inexpensive, its correlates in adjustment and its insights into the individual's perception of himself make it a valuable addition to a test battery. The techniques of using it can be made readily intelligible to faculty advisers, and its implications for a counseling program are obvious. As a method of approaching the self-concept dimension of personality, this technique merits further study.

Surprisingly little work seems to have been done in interest measurement in spite of Super's (89) expressed concern for the discrepant meanings of similar interest patterns in individuals with appropriate and those with inappropriate self-concepts. Layton (57) reported on a fruitful conference on the Strong Vocational Interest Blank at the University of Minnesota in

February, 1955, out of which some important developments may grow. Matteson (61) made some progress in the methodology of studying interest-experience relationships through the development of an activity check list for inventorying experiences in a systematic way. His approach appears promising.

Another measurement area that has been little explored is that of biographical data. Dressel (29) called attention to this oversight, but the year's publications disclose no significant attempts to develop this means of assessment in counseling contexts to the degree of precision and utility which it probably can attain.

#### WORK AND OCCUPATIONS

Freud somewhere remarked that work was the chief means of binding the individual to reality. In a little-known article, Bell (12) last year analyzed changes in the industrial situation in terms of the concepts of reality they tend to present to factory workers. He argues that with the satisfactions of craftsmanship essentially eliminated by mass production methods, the gratifications bound up with industrial jobs are essentially those of human associations. This change underlies the "human relations" approach in management and the emphasis put upon "communication" and "participation" in plant operations. According to Bell, this development has two major implications. One is that psychological manipulation has replaced authority as a way of exercising managerial dominion. The other is that it has made nearly all satisfactions dependent upon the fellowship of a group, leisure pursuits, aspirations for promotion, etc. The first imposes a subtle strain on workers that may have psychological consequences of importance. The second means that satisfactions in one's job, *per se*, are rather rare.

Whatever one may think of this analysis, it represents the kind of sociological concern that is both meaningful for and neglected by counseling psychologists. That there is a shift toward more attention to these issues is reflected in the publication of Caplow's (17) valuable and scholarly book, which deals sociologically with the problems of status and work, occupational ideologies, the labor movement and the labor market, vocational choice, working conditions, and occupations as they affect family relationships.

More psychologically, Roe (73) reported a new classification of occupations as a way of organizing the accumulating data on occupation and personality. The classification is a two-fold affair, taking into account both the primary focus of the activity involved and the level of responsibility and skill demanded. Developed as a preliminary to a book on occupational psychology, the scheme's full utility must await the later appearance of the volume.

Among those studies more directly related to the counselor's task, Rusalem (77) made a strong case for the use of occupational information as related to the emotional life of the client. His contentions bear a relationship

to Bell's analysis of the industrial situation and are oriented toward self-concept forms of personality theory. It seems strange that no genuine research has been done on the matter of the kinds of occupational information and their modes of presentation as they affect client outcomes. Here again is a gap in knowledge that must be bridged by inquiry rather than argument.

Another important paper was Beilin's (9) attempt to apply principles of general human development to the vocational area. Able to show at a convincing conceptual level that Ginzburg's and Super's theories of vocational development are special cases of general developmental theory, Beilin asserts that changes in an individual's relationship to work proceed lawfully as a function of age and experience. A host of research problems of theoretical and practical importance come at once to mind, and the relationship of this kind of theoretical point of view to more general forms of psychological theory is to be commended. Nevertheless, the task of testing the hypotheses generated by this basic idea is not easy. Miller (65), for example, was unable to find differences in job values as a function of age among college men, although perhaps his age groups did not extend over a sufficient range. Singer & Steffle (84), on the other hand, were able to show that adult males are more interested in work where they could enjoy a degree of independence, whereas male adolescents were more concerned with money, fame, and "glamor." Such findings, while by no means unimportant, are hardly startling and do not contribute much toward that theoretical solidity which marks genuine understanding. Dickinson (28), however, found some rather important differences in job values among college seniors. Those seeking entry into the business fields, for example, tend to prize advancement, while those aspiring to be teachers are more interested in human relations, job security, and working conditions. These results, if stable, should be of value in actual counseling situations, and an examination of their personality correlates could conceivably clarify a number of theoretical issues affecting occupational choice and vocational development.

#### AN EVALUATION

The past year has seen a continuation and a maturing of the rapid professionalization that has characterized counseling psychology during its relatively brief history. It has expanded its service functions and appropriately allowed its intellectual borders to widen to keep pace with service developments.

Perhaps the most striking aspect of these broadening intellectual horizons has been the translation of many professional issues into substantive ones. This focusing of psychological concepts and methods on professional problems has meant the beginnings of an intensive study of psychologists. In turn, this kind of self-study may lead to a more rational and dispassionate settlement of professional difficulties, and, since the counselor seems to be a central variable in the counseling process, a greater degree of enlightenment about the methods of helping troubled people.

Nevertheless, a heavy atmosphere of practicality seems to hang over the field. The year produced little daring but rigorous theorizing. The research output seems to be in bits and pieces rather than integrated and deriving its motive force from some unifying and fundamental idea or from some conflict between such ideas. Scholarship appears workmanlike but lacking in sweep, and one suspects that scholarly attainment is not highly prized.

Similarly, this emphasis on the practical apparently underlies a fantastic quantity of publication. Over 100 articles were rejected in this review as either trivial, unrepresentative, or merely programmatic. The criticism that counseling psychologists are neither interested nor active in research, however, is simply not warranted. Activity is remarkably high, interest is keen, and investigative sophistication is obviously considerable. While there are many unexplored domains in the field, the awareness of them seems sharp, and such blank spots are hardly surprising or unhealthy in so new a specialty or in one so complex.

Too, counseling psychology appears for the most part to have maintained its connections with general psychology. Any professional application of a science risks a certain tendency to take its point of departure from the applications and to lose touch with its intellectual roots, but this risk appears minimal here.

It seems fair to say that the last year has presented many challenges to inventive thought and inquiry. One may look forward with justified anticipation to their fulfillment and to the vigorous establishment of new ones.

## LITERATURE CITED

1. American Board of Examiners in Professional Psychology, *The Certification of Advanced Specialists in Professional Psychology* (American Psychological Association, Washington, D. C., 16 pp., 1953)
2. APA, *Ad Hoc* Committee on Relations between Psychology and Other Professions, *Am. Psychologist*, **8**, 546-50 (1953)
3. APA, Division of Counseling and Guidance, Committee on Counselor Training, *Am. Psychologist*, **7**, 175-81 (1952)
4. APA, Division of Counseling and Guidance, Committee on Counselor Training, *Am. Psychologist*, **7**, 182-88 (1952)
5. APA, Division of Counseling Psychology, Counselor Training Committee, *J. Counseling Psychol.*, **1**, 174-79 (1954)
6. APA, Education & Training Board, *Am. Psychologist*, **9**, 258 (1954)
7. Arnhoff, F. N., *J. Clin. Psychol.*, **10**, 272-75 (1954)
8. Arsenian, S., and McKenzie, F. W., *Counseling in the YMCA* (Association Press, New York, N. Y., 126 pp., 1954)
9. Beilin, H., *J. Counseling Psychol.*, **2**, 53-57 (1955)
10. Bendig, A. W., *J. Clin. Psychol.*, **11**, 127-32 (1955)
11. Bendig, A. W., and Sprague, J., *J. Consulting Psychol.*, **18**, 207-11 (1954)
12. Bell, D., *Encounter*, **2**(6), 3-15 (1954)
13. Bialick, I., and Hamlin, R. M., *J. Consulting Psychol.*, **18**, 239-42 (1954)
14. Bordin, E. S., *J. Consulting Psychol.*, **19**, 9-15 (1955)
15. Bordin, E. S., *J. Counseling Psychol.*, **2**, 17-21 (1955)
16. Calvin, A. D., *J. Counseling Psychol.*, **1**, 249-51 (1954)
17. Caplow, T., *The Sociology of Work* (University of Minnesota Press, Minneapolis, Minn., 330 pp., 1954)
18. Cohen, M. R., *American Thought* (The Free Press, Glencoe, Ill., 360 pp., 1954)
19. Combs, A. W., *Am. Psychologist*, **8**, 554-63 (1953)
20. Cottle, W. C., *Personnel Guid. J.*, **31**, 445-50 (1953)
21. Cottle, W. C., and Lewis, W. W., Jr., *J. Counseling Psychol.*, **1**, 27-30 (1954)
22. Cottle, W. C., Lewis, W. W., Jr., and Penney, M. M., *J. Counseling Psychol.*, **1**, 74-77 (1954)
23. Cottle, W. C., Pownall, J. E., and Steimel, J., *Personnel Guid. J.*, **33**, 374-78 (1955)
24. Cottle, W. C., and Wands, H. E., *J. Counseling Psychol.*, **2**, 28-31 (1955)
25. Cummings, S. T., *J. Consulting Psychol.*, **18**, 243-47 (1954)
- 25a. Danskin, D. G., *J. Counseling Psychol.*, **2**, 22-27 (1955)
- 25b. Danskin, D. G., and Robinson, F. P., *J. Counseling Psychol.*, **1**, 78-83 (1954)
26. Davenport, B. F., *J. Consulting Psychol.*, **16**, 171-75 (1952)
27. De Charms, R., Levy, J., and Wertheimer, M., *J. Clin. Psychol.*, **10**, 233-35 (1954)
28. Dickinson, C., *J. Counseling Psychol.*, **1**, 188-89 (1954)
29. Dressel, P. L., *J. Counseling Psychol.*, **1**, 100-5 (1954)
30. Dressel, P. L., *Personnel Guid. J.*, **33**, 4-7 (1954)
31. DuBois, P. H., Teel, K. S., and Petersen, R. L., *Educ. Psychol. Measurement*, **14**, 605-16 (1954)
32. Dymond, R. F., *J. Consulting Psychol.*, **19**, 103-7 (1955)
33. Edwards, A. L., *Edwards Personal Preference Schedule* (Psychological Corporation, New York, N. Y., 18 pp., 1954)



34. Ellis, A., *Am. Psychologist*, **8**, 551-53 (1953)
35. Ewing, T. N., *J. Counseling Psychol.*, **1**, 232-39 (1954)
36. Eysenck, H. H., *J. Consulting Psychol.*, **16**, 319-24 (1952)
37. Fiedler, F. E., *Psychotherapy: Theory and Research*, 296-315 (Mowrer, O. H., Ed., The Ronald Press Co., New York, N. Y., 700 pp., 1953)
38. Fletcher, F. M., Jr., *J. Counseling Psychol.*, **1**, 240-43 (1954)
39. Froehlich, C. F., and Moser, W. E., *J. Counseling Psychol.*, **1**, 149-52 (1954)
40. Garfield, S. L., Heine, R. W., and Leventhal, M., *J. Consulting Psychol.*, **18**, 281-86 (1954)
41. Gill, M., Newman, R., and Redlich, F. C., *The Initial Interview in Psychiatric Practice* (International Universities Press, Inc., New York, N. Y., 423 pp., 1954)
42. Gustad, J. W., *J. Counseling Psychol.*, **1**, 243-46 (1954)
43. Hahn, M. E., *J. Counseling Psychol.*, **1**, 246-48 (1954)
44. Hahn, M. E., and MacLean, M. S., *General Clinical Counseling* (McGraw-Hill Book Co., Inc., New York, N. Y., 375 pp., 1950)
45. Hamilton, K. W., *Counseling the Handicapped in the Rehabilitation Process* (The Ronald Press Co., New York, N. Y., 296 pp., 1950)
46. Hamlin, R. M., *J. Consulting Psychol.*, **18**, 233-38 (1954)
47. Heyns, R. W., *Am. Psychologist*, **8**, 570-71 (1953)
48. Holt, R. R., and Luborsky, L., *Bull. Menninger Clin.*, **16**, 125-35 (1952)
49. Holtzman, W. H., and Sells, S. B., *J. Abnorm. Social Psychol.*, **49**, 485-90 (1954)
50. Humphreys, J. A., and Traxler, A. E., *Guidance Services* (Science Research Associates, Chicago, Ill., 438 pp., 1954)
51. Jensen, B. T., Coles, G., and Nestor, B., *J. Counseling Psychol.*, **2**, 58-61 (1955)
52. Kahn, T. C., *Am. Psychologist*, **10**, 171-72 (1955)
53. Kelly, E. L., and Fiske, D. W., *The Prediction of Performance in Clinical Psychology* (University of Michigan Press, Ann Arbor, Mich., 311 pp., 1951)
54. Kelly, G. A., *Am. Psychologist*, **10**, 172-73 (1955)
55. Koester, G. A., *Educ. Psychol. Measurement*, **14**, 473-86 (1954)
56. Korner, I. N., and Westwood, D., *J. Clin. Psychol.*, **11**, 167-70 (1955)
57. Layton, W. L., *J. Counseling Psychol.*, **2**, 10-12 (1955)
58. *Am. Psychologist*, **8**, 572-84 (1953)
59. Levin, H., *J. Consulting Psychol.*, **18**, 303-6 (1954)
60. Loevinger, J., *Educ. Psychol. Measurement*, **15**, 3-17 (1955)
61. Matteson, R. W., *J. Counseling Psychol.*, **2**, 13-16 (1955)
62. McArthur, C., *J. Counseling Psychol.*, **1**, 203-7 (1954)
63. Meehl, P. E., *Clinical vs. Statistical Prediction* (University Minnesota Press, Minneapolis, Minn., 149 pp., 1954)
64. Meehl, P. E., *J. Counseling Psychol.*, **1**, 207-8 (1954)
65. Miller, C. H., *J. Counseling Psychol.*, **1**, 190-92 (1954)
66. Miller, L. M., Garrett, J. F., and Stewart, N., *Personnel Guid. J.*, **33**, 444-47 (1955)
67. Mowrer, O. H., Ed., *Psychotherapy: Theory and Research* (The Ronald Press Co., New York, N. Y., 700 pp., 1953)
68. Newton, R. L., *J. Consulting Psychol.*, **18**, 248-50 (1954)
69. Oppenheimer, O., *J. Counseling Psychol.*, **1**, 184-87 (1954)
70. Pepinsky, H. B., and Pepinsky, P., *Counseling Theory and Practice* (The Ronald Press Co., New York, N. Y., 307 pp., 1954)

71. Robins, E., and Mensh, I. N., *J. Abnormal Social Psychol.*, **49**, 435-42 (1954)
72. Robinson, J. T., and Cohen, L. D., *J. Clin. Psychol.*, **19**, 333-36 (1954)
73. Roe, A., *J. Counseling Psychol.*, **1**, 215-20 (1954)
74. Rogers, C., and Dymond, R. F., Eds., *Psychotherapy and Personality Change* (University of Chicago Press, Chicago, Ill., 447 pp., 1954)
75. Rogers, L. B., *J. Counseling Psychol.*, **1**, 224-31 (1954)
76. Rosenzweig, S., *J. Abnormal Social Psychol.*, **49**, 298-304 (1954)
77. Rusalem, H., *J. Counseling Psychol.*, **1**, 84-88 (1954)
78. Sanderson, H., *Basic Concepts in Vocational Guidance* (McGraw-Hill Book Co., Inc., New York, N. Y., 338 pp., 1954)
79. Sanford, F. H., *Am. Psychologist*, **10**, 93-96 (1955)
80. Sanford, F. H., *Am. Psychologist*, **10**, 135-38 (1955)
81. Schwebel, M., *Personnel Guid. J.*, **33**, 254-59 (1955)
82. Shaffer, L. F., *Am. Psychologist*, **8**, 608-23 (1953)
83. Shoben, E. J., Jr., in *Psychotherapy: Theory and Research*, 120-39 (Mowrer, O. H., Ed., The Ronald Press Co., New York, N. Y., 700 pp., 1953)
84. Singer, S. L., and Steffire, B., *J. Counseling Psychol.*, **1**, 89-91 (1954)
85. Singer, S. L., and Steffire, B., *J. Counseling Psychol.*, **1**, 252-55 (1954)
86. Snyder, W. V., *J. Counseling Psychol.*, **2**, 47-52 (1955)
87. Solomon, L. N., *Am. Psychologist*, **10**, 170-71 (1955)
88. Strupp, H. H., *J. Consulting Psychol.*, **19**, 1-7 (1955)
89. Super, D. E., *J. Counseling Psychol.*, **1**, 168-71 (1954)
90. Super, D. E., *J. Counseling Psychol.*, **2**, 3-9 (1955)
91. Super, D. E., *Personnel Guid. J.*, **33**, 8-14 (1954)
92. Taft, R., *Psychol. Bull.*, **52**, 1-23 (1955)
93. Thompson, A. S., *Personnel Guid. J.*, **33**, 533-35 (1954)
94. Thorndike, R. L., and Hagen, E., *Measurement and Evaluation in Psychology and Education* (John Wiley & Sons, Inc., New York, N. Y., 575 pp., 1955)
95. Torrance, E. P., *Educ. Psychol. Measurement*, **14**, 120-27 (1954)
96. *Training of Psychological Counselors* (University of Michigan Press, Ann Arbor, Mich., 29 pp., 1950)
97. Warters, J., *Techniques of Counseling* (McGraw-Hill Book Co., Inc., New York, N. Y., 384 pp., 1954)
98. Wiener, D. N., *Am. Psychologist*, **8**, 564-69 (1953)
99. Witryol, S. L., and Boly, L. F., *J. Counseling Psychol.*, **1**, 63-69 (1954)
100. Windel, C., *Educ. Psychol. Measurement*, **14**, 617-33 (1954)
101. Wyatt, F., *Am. Psychologist*, **9**, 522-38 (1954)

## ASSESSMENT OF INDIVIDUAL DIFFERENCES<sup>1,2</sup>

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Assessment may be defined as the obtaining and evaluating of information regarding individual differences. Topics usually covered under the heading of "Individual Differences" are treated here. Space restrictions limit the review to major trends in the (estimated) 20,000 pages of relevant material considered.<sup>3</sup>

### THE FAILURE OF GLOBAL ASSESSMENT

Assessment in the OSS style has now been proved a failure. Earlier validation studies are reviewed by Symonds (164) and Kelly (99). In the Menninger project on assessment of 457 psychiatric trainees, neither tests nor psychiatric interviews had satisfactory validities (117). Holtzman & Sells (87) supplied projective data on student pilots to 19 prominent clinicians. The clinicians agreed with each other in identifying men eliminated on emotional grounds but could not agree with the criterion. In the Swedish Army, interviewers added negligibly to validity from tests [Husén (90)].

More favorable evidence is reported by Biesheuvel *et al.* (14). Among South African air cadets, psychomotor tests predicted pass-fail with validity .46. Ratings based on observation correlated .45 and the two yielded a multiple *R* of .62. An assessment of potential submariners correlated .28 with a later shipboard criterion in a group of restricted range [Mackie *et al.* (118)]. In both studies, ratings may have been based in part on ability rather than temperament.

Assessment encounters trouble because it involves hazardous inferences. Very little inference is involved when a test is a sample of the criterion or when an empirical key is developed. Simple test interpretations involve inference from test to construct to behavioral prediction. But assessors attempt a maximum inference from tests. As current writers describe the process (e.g., 9, 44, 100, 121, 124, 152), personality theory is applied to weave nomothetic constructs into a construct of the individual's personality structure; predictions are then derived by inferring how that structure will interact with the known or guessed properties of the situation. Assessors have been foolhardy to venture predictions of behavior in unanalyzed

<sup>1</sup> The survey of the literature pertaining to this review was completed in May, 1955.

<sup>2</sup> The following abbreviations are used in this chapter: MMPI (Minnesota Multiphasic Personality Inventory); PMA (Primary Mental Abilities); TAT (Thematic Apperception Test).

<sup>3</sup> Bibliographic assistance from Jack C. Merwin and Leonardo Ancona is gratefully acknowledged.

situations, using tests whose construct interpretations are dubious and personality theory which has more gaps than solid matter. Symonds (164) has this afterthought, "It is doubtful whether the TAT can be expected on theoretical grounds to predict any tangible overt expression of personality such as might be exemplified in academic success or work proficiency." And Luborsky (117) says, "Reviewing some predictions on which we erred, we were impressed with our correct assessment of many specific qualities and our inability to cast these up into proper balance so as to judge ability to develop skill as a psychiatrist."

The negative findings on maximum inference have to some extent divided psychologists between a conservative and an imaginative camp. Name-calling appears, as in Bellak's reference, while defending TAT, to "methodological bluenoses (who often mistake obsessive doubt for a scientific attitude and their intellectual sterility for caution and eclecticism)" (9, p. x). With poetic justice, the Fishers (56) employ a picture interpretation test to show that objectively-oriented psychology students are less insecure than those who are more intuitive. Simoneit (159) argues vehemently that objectification loses psychological meaning and that characterological study of the expressive behavior of the subject is required. Meili (125) counterattacks, arguing that *Ausdruckspsychologie* suffers from the same limitations as formal tests and has equal need for controlled research.

Others who recognize the schism speak more moderately. Cronbach (38) prevailed upon an anthropologist to describe dispassionately the national character of Clinicians and Psychometrikans. Rosenwald (145) criticizes research which seems "almost designed to devalue" clinical tests, but also shows that clinical reports are often made useless by unspecific descriptions and overliterary writing [see also McArthur (121)]. To dispel any belief that oceans separate measurer from *Versteher*, it remains only to cite this advice on assessment from that arch-measurer, Sir Cyril Burt: "The final case-summary should comprise, not merely analytic assessments in quantitative terms of the chief key-tendencies or 'factors,' but also a synthetic character-sketch, giving a qualitative picture of the individual, viewed as a dynamic, integrated, and unique human being" (23, p. 28). The critical question is why inferences go wrong, not whether inference is a legitimate mode of test interpretation.

#### THE CLINICAL PROCESS

*Value of clinical judgment.*—In experiments where clinicians and statistical formulas predict the same criterion, the formulas always do better [Meehl (124)]. Melton (126) found actuarial predictions of grade averages superior to those by counselors even when the counselors were given added data and the actuarial table itself. Halbower (75) obtained therapists' Q-sort descriptions of nine cases having the same MMPI pattern and used the modal sort as an actuarial key. This key was a better description for nine

new cases than was a sort made by a clinician directly from each individual's MMPI profile. This is the first use of actuarial methods to obtain a qualitative case description.

According to Meehl: An actuarial formula should be prepared for any recurrent decision. The unique function of the clinician is to predict micro-events, such that no statistical experience table can be prepared in time to be useful. The clinician can create new idiosyncratic constructs and thus predict the unprecedented. Such predictions are helpful during therapy, where no harm is done if many tries are erroneous because the subsequent interaction identifies the correct ones.

Even in the studies Meehl reviews, the clinical judge adds valid variance. But he makes overbold predictions, underweights relevant scores in favor of his clinical data, employs stereotypes instead of admitting his ignorance of what makes a good pilot or psychiatrist, and commits himself to a single "most likely" personality structure instead of reporting the tenable alternatives. These faults can be overcome. Wilson (178) interviewed subjects and estimated their scores on conventional tests of dominance, adjustment, and mental ability with validities .66 to .81. Cronbach (38, 39; see also 23) argues that certain assessment techniques have been unduly discredited. A procedure which covers many dimensions with low validity may have advantages over a single accurate test which answers only one question. Interviews and projectives have value for identifying which traits should be explored most thoroughly in the individual case.

*Testing as a social act.*—Test research has been dominated by the Galtonian view that the test is a sample of the subject's response to a standardized nonpersonal stimulus. Sarason (150) ably defends the contrary view that testing is a social interaction. Attitudes toward the tester, learned anxiety about tests, etc., modify the performance and the interpretation. Schafer's brilliant and absorbing chapter on "interpersonal dynamics in the test situation" (152) should be engraved on the heart of every tester. The following are examples of his provocative conclusions: such a test as the Wechsler should be administered in an unstandardized fashion; the role of the tester is "voyeuristic, autocratic, oracular, and saintly."

*The assessor's implicit personality theory.*—Bruner & Tagiuri (21) note that errors in interpretation of tests arise from the judge's implicit theory of trait interrelations. Walker (172) shows how such factors confuse communication in assessment reports; for example, psychologists regard sales effectiveness as dependent on verbal rather than nonverbal intelligence, but executives do not make this distinction. "Soundness" of graduate students is, among faculties, nearly synonymous with effectiveness, but psychologists emphasize warmth and de-emphasize eccentricity (5). Psychologists overweight introspectiveness in judging intelligence. Other evidence on this aspect of judgment comes from several studies (41, 69, 95, 96, 162).

## MODELS FOR ASSESSMENT

Eysenck discusses his views in several papers (50, 51, 53). At one pole he sees the Americans as trying to find ever more specific factors, a style which he attributes to their *S-R* tradition. At the other pole he places the Germans, whose typologies reflect a distrust of the quantitative. He believes that factor analytic dimensions may be organized hierarchically to describe types of persons. Burt (23) likewise accepts a hierarchy of traits. Eysenck emphasizes the factors of introversion and neuroticism. Among neurotics, the extrovert and introvert poles have their biological roots in Pavlov's inhibition and excitation, respectively. In supporting experiments by himself (49) and Franks (65), hysterics are less readily conditioned and more susceptible to figural after-effects than dysthymics (cf. 176).

Cattell (29) upholds simple structure against Eysenck's criterion rotation, but rejects the idea that factor analysis is presently ready for predictive use. Varied studies on individual differences [for example (82, 151, 181)] obtain data suited to Guttman's new radex model (73) for factor analysis, which may be preferable to arbitrary simple structure analysis.

Léon (105) comments on Russian reports to the Montreal Congress. The Russian view is that individual differences are developed by experience; appropriate remedial treatment of a motivated subject can radically alter specific abilities. The only biological verities are the Pavlovian dimensions (cf. Eysenck, above).

*Pattern and profile methods.*—Stephenson's efforts to use questionnaires to study each individual separately are well known. Technical reviews of his book (163) make clear that *Q*-methodology is treacherous. Cronbach & Gleser (40) praise the device of administering the same questions under varying instructions, but raise serious objections to the forced normal distribution, use of analysis of variance, and other features of the system. Eysenck (52) adds further criticisms.

Tiedemann & Bryan (167) demonstrate their centour technique, measuring how similar a student's interests are to typical successful students in each curriculum. The procedure involves the assumption that it is good for the student to enter the curriculum where he is typical. One may question the advantage of this approach over the fundamentally different multiple regression method.

*Idiosyncratic analyses.*—The Osgood "semantic differential" method of studying meaning systems is very promising for studying the individual case. Osgood & Luria (139) applied this method to the Thigpen-Cleckley case of triple personality, testing each personality in turn(!) and achieving a successful blind analysis.

Very similar ideas are elaborated by Kelly (100) in the first of two volumes on *The Psychology of Personal Constructs*. In his ingenious Role Construct Repertory Test, the subject first lists a large number of significant others in his life, and then lists attributes which distinguish certain individuals from others. This yields 15 scales important for this individual, on

which he describes all the significant others. The investigator studies the correlation among constructs, the perceived similarity among individuals, etc. The technique is indirect and exceptionally flexible but has serious technical deficiencies. The complexity of the data has lured Kelly's students into analyses so involved as to obscure serious errors in reasoning.

#### CRITERION-ORIENTED STUDIES: ABILITY

Anastasi (1) believes that traditional ability categories can be replaced by empirically defined group factors. Regression equations for differential tests against significant criteria, and interpretative rationale based on evidence are badly required, she adds. Terman (165) questions what specific ability factors add to prediction:

The experts in this field are divided into two schools. The British school, represented by Thomson, Vernon, and Burt, usually stop with the identification of at most three or four group factors in addition to *g*, while some representing the American school feed the scores of 40 or 50 kinds of tests into a hopper and manage to extract from them what they believe to be a dozen or fifteen separate factors. . . . It is to be hoped that further research will give us more information than we now have about the predictive value of the group factors. Until such information is available, the scores on group factors can contribute little to vocational guidance beyond what a good test of general intelligence will provide.

*Differential batteries.*—Berdie (11) studied four-year achievement in several college curricula. Vocational interest scores differentiated such groups, but differential abilities (PMA) did not predict field of concentration. Moreover, PMA was a less effective predictor of over-all grade average than were more general tests of aptitude or achievement.

A revised manual and technical supplement for PMA for ages 7 to 11 (166) shows little caution and much improper technical reporting. No evidence is reported for the dubious claim that the space ability is important in handcraft, art, geometry, etc., nor for the predictive advantage over mental age of the new "reading" and "arithmetic aptitude" scores. In contrast, new batteries by Holzinger & Crowder (88) and Segel & Raskin (157) are excellently presented. Striking variation is found in concurrent correlations with different achievement measures in the same field and with different samples. The tests often do not correlate where they are expected to correlate [see also Wolking (179) on PMA and the Differential Aptitude Tests]. In the Segel and Raskin data, arithmetic computation has the highest or nearly highest validity for virtually every high school subject. In shop, the highest validity is for paragraph meaning and one of the lowest for "applied science and mechanics." In neither battery does space show predictive value. We conclude that while factorial scores may be useful for a theory of abilities, as soon as testers make inferences to behavior in significant situations they encounter the same troubles as personality assessors. Group factors serve only when regression equations are constructed about the criterion in a single institution.



Flanagan's differential battery (59) measures 14 variables. Stanine scores for various occupations are based on formulas developed in an armchair. The printer is said to require superior judgment, comprehension, and expression; the same scores, supplemented by good memory(!), qualify one to be a professor of humanities. Of the two validation studies offered, the first is utterly irrelevant to this battery and the second is reported too sketchily to be meaningful. Publication with this manual is a step backward.

The doubtful practical status of differential testing is underlined by an announcement that the American Council on Education Test will be withdrawn from the market. This was the first fruit of multiple-factor research and sought to measure linguistic and quantitative "aptitudes." It will be replaced by the "Cooperative School and College Ability Test," which frankly measures verbal and quantitative achievement and is to be used to locate remedial needs as much as for prognosis.

*General intelligence tests.*—The important new general tests are the Lorge-Thorndike Intelligence Tests for Kindergarten to Grade 12 (116), the individual Columbia Mental Maturity Scale (22), and the Wechsler Adult Intelligence Scale (174) which replaces the old Form I. The Adaptability Test (168) and the Short Employment Tests (10) are provided with good new manuals.

The nonverbal "semantic" test by Rulon & Schweiker (147) is validated against achievement of slow-learning Marines; it predicts appreciably better than the General Classification Test or Army Beta. Porteus (142) gives evidence for qualitative scoring of Maze performance. Wand & Mollenkopf (173) review 194 references on aptitude tests used for women.

#### THE NATURE OF ABILITIES

*Cultural factors.*—Fahmy (54) tested children from the extremely restricted environment of the Southern Sudan and found ample evidence of cultural influences. The mean IQs on four tests were Goddard 74, Porteus 76, Goodenough 50, and Alexander 97. These children have no concept nor perception of the straight line and lack drawing experience. But the Alexander Passalong involves colored blocks, and colors are much emphasized in this culture. Biesheuvel (13) describes the testing of other primitive African groups, including performance testing for gold mine labor with pantomime motion picture instructions.

Twenty-eight American groups of differing social class were given tests by Haggard (74) under various conditions of motivation, practice, item form, etc. In general, the pupils of low status showed as much ability to learn as the "highs" and gained more under the conditions most familiar to them. Differences between lows and highs decreased under motivation and practice. Mere revision of items does not remove status differences; performance depends on the psychology of the testing situation.

*Coaching.*—In Britain, where tests at age 11 determine one's educational career, coaching has been thoroughly investigated. A symposium summa-

rized by Vernon (171) indicates that coaching plus practice on complete tests under standard conditions can raise IQs about 9 points. Practice alone has little effect. There is greater retest change among maladjusted children and on the more complex items. Holloway (84) studied the effect of the Thurstone Red Book on five-year-olds in preschool. The PMA IQ was raised significantly (13 points), but IQs on the Wechsler Scale for Children were unaffected. Hurtig (92) examined whether Progressive Matrices scores could be improved by supplementary explanation before retest. In the feeble-minded, changes up to 16 IQ points had been found. The main study is inconclusive because of poor statistical design but suggests that explanations are differentially helpful. According to Heim (80), the child will pass items, presented amid difficult items, which he fails in an easy context.

*Growth and development.*—Burt (24) examines whether abilities become more differentiated with age, severely criticizing the methods of past studies. In his own longitudinal data, his general factor accounts for much more variance at age 13 than at age 9. The statistical and semantic issues in this area are not, however, easily disentangled. Husén (91) found that twins have double the normal expectancy of falling in the lowest intelligence range. He suggests that this may be attributable to premature births among twins. The rest of his data, on 3000 cases, confirm previous research. Among mental defectives, Clarke & Clarke (35) found increases of 10 points in IQ after two years very common among subjects coming to the institution from bad homes.

*Factor studies.*—Zimmerman (181) hypothesizes that with increases in difficulty superficially similar spatial items will shift from measuring perceptual speed to spatial to visualization to reasoning. Using suitable reference tests, he confirms this except as regards reasoning.

The most significant contribution to the study of abilities since World War II is the program of Fleishmann & Hempel on psychomotor abilities. Information is available in numerous military reports and some journal articles, several of which fall in the current year (60 to 63, 81). In the interests of a comprehensive summary, we draw on an unpublished review of the program made available by Fleishmann. The work is intended to define the variables in motor tests and to determine the significance of these variables for prediction. Apparatus tests have considerable utility in predicting pilot success and school success of electricians, etc. Factorial studies covering dexterity (61), physical proficiency (81), simple psychomotor tests, and complex coordinations sharpen older factors and indicate new ones. Pencil-paper tests are not factorially similar to apparatus tests. These factor studies characterize almost every available psychomotor test in terms of general constructs, and new tests are devised to measure factors with considerable purity. Work by Brozek & Taylor (20) provides material to be integrated with that of Fleishmann. These authors seem more inclined than Fleishmann to emphasize the narrowness of the factors identified.

Of greatest importance is the finding in both programs that each test has

different meanings in different groups, a point consistent with the results of Heim and Zimmerman. Early and late in practice, tests and criterion skills have different makeup. In the Complex Coordination Test (62), only coordination is a major factor at all stages of practice. At early stages, cognitive abilities contribute heavily, but these diminish in influence while rate of movement and a test-specific factor become more prominent. The Discrimination Reaction Time Test behaves similarly.

Failure of assessment using data other than worksamples results in part from specifics in the criterion. When a person performs in a single situation for a long time, patterns of motor, cognitive, affective, and interpersonal behaviors learned specifically in that situation account for considerable variance [cf. Ferguson (55)]. Tests measure where a person starts from and predict how rapidly he will learn, not what reaction he will fix upon; yet that is ultimately required for assessment.

#### PERSONALITY MEASUREMENTS

Burt (23), Loevinger (114), Hutt (93), and Zubin (182, 183, 184) evaluate approaches to personality testing in important papers. Cattell and associates recount further factor analytic forays into personality (30, 31, 32). Their results seem too much open to sampling error, when correlations for 100 persons are made to yield 20 or so factors.

*Questionnaires: (a) Procedural studies.*—There is much debate regarding the merits of forced and unforced responses. Forced choice controls social desirability but cannot prevent all distortion [Durnall (46)]. Brogden (17) provides a technique for eliminating distortion when just one criterion is to be predicted and demonstrates its superior validity. Osburn and others (138) cite four recent unpublished studies claiming superior validity for forced-choice self-descriptions against leadership criteria.

Taken together with the past literature, and supplemented by three new sets of data (34, 36, 97), the Osburn study permits us to resolve contradictory findings on the forced versus unforced issue. A forced-choice item is less valid but less correlated with other items than is a comparable unforced item. Since each response in forced-choice is more saturated with valid variance, forcing is advantageous but only in a lengthy instrument. At lengths where the empirical difference is slight, the unforced form appears preferable because of its ease of construction and acceptability to subjects and its suitability for certain statistical analyses. In the unforced method, façade or response-set variance should be scored as such and often partialled out.

Fricke (68) found that a configural key based on patterns of responses consistently correlated higher with college achievement than a conventional key based on separate items. Secord (156) exposes serious faults in McQuitty's configural studies. Response sets such as acquiescence continue to appear as major sources of variance in questionnaires (31, 130).

*Questionnaires: (b) Specific instruments.*—The Edwards Personal Prefer-

ence Schedule (47) uses 225 paired comparisons to obtain self-reports on 15 Murray needs. The self-description is perhaps the most useful available among present tests for counseling. Façade is well removed; a social desirability score correlates only  $-.32$  to  $.32$  with Edwards scores, compared to  $.60$  with Guilford-Martin and reflected Taylor scores (see also 135).

The Taylor Anxiety (A) Scale has been a focus of research. Taking note of the finding that façade accounts for much of the variance, Kabrick (97) developed a refined forced-choice version. This scale has reliability  $.56$ , compared to  $.85$  for the A scale, and much less correlation with the MMPI K scale. A study of validity with a rather weak design leads to ambiguous but promising results. The Taylor scale correlates  $.92$  with MMPI Pt (16, 48), and both of these correlate around  $.90$  with a clinical rating of optimism (48).

Sampson & Bindra (148) report a zero correlation of A scores with clinical ratings while Buss and others (25) find a correlation of  $.60$ , but the latter data were obtained under conditions which might give an artificially high value. On the whole, the Taylor scale appears neither better nor worse than other adjustment questionnaires.

A number of investigators (3, 64, 106, 131, 153, 154, 158) try to determine whether different scores supposed to reflect authoritarianism or rigidity or both are correlated. The results are contradictory. In those studies which reject a general factor, the reliability of the measures is uncertain; in those which find positive relations, test-taking attitudes may provide an adequate explanation. Two studies report factor analysis of items. A general factor plus a group factor for religious items seems adequate to account for the O'Neil-Levinson data (137) but Saunders' (151) data require five factors representing different attitudes toward others.

Black (15) discusses use of MMPI with college women, reporting that their mean is substantially higher than the standardization group (see also 33, 71), describing cross-sectional trends with age, and summarizing relations of MMPI scores to peer ratings on 15 traits. These data make evident the necessity for determining the meaning of a particular score or pattern within any subculture, as opposed to applying one set of interpretations universally.

In an important program of research, Clark and others (34) have developed a Navy interest inventory with keys for Navy and civilian occupations. The scales separate men-in-job from men-in-general with about 35 per cent overlap, and correlate about  $.30$  with grades in technical school. Carter (27) finds a zero correlation of Kuder scores with grades in engineering. Lipsett & Wilson (111) followed 700 adults for one year, obtaining estimates of job satisfaction. The statistical treatment is unsatisfactory, but the data indicate higher satisfaction when people are in jobs consistent with measured ability and interest. Layton (103) reviews several current studies of the Strong Blank.

*Projective techniques: (a) Picture interpretations.*—Bellak (9) provides a

thoughtful but incautious manual on TAT and Children's Apperception Test. He regards the performance as a sample of ego-functioning rather than a sheer expression of drives. He gives particularly clear examples of interpretative procedure and rationale. More introductory and much less daring is Stein's revised TAT manual (161). He stays close to Murray's original views, in contrast to Bellak's psychoanalytic orientation. Both writers neglect validation.

That validation research is needed is demonstrated by Meyer & Tolman (127), who try to determine whether perceptions of TAT figures are representative of the subjects' attitudes toward significant others. Images of parent figures did not correspond to attitudes expressed in early therapeutic interviews. McIntyre (123) required subjects to describe, on MMPI items, themselves and also the TAT figures. One may quarrel with the assumption that similarity of these descriptions is a measure of projection. There was little projection in this sense, and subjects did not project more onto figures physically similar to themselves or onto vague figures. According to Milam (128), an unfriendly examiner elicits longer and more anxious TAT stories. Four other studies show effects of immediate motivational factors on thematic tests (66, 109, 134, 140).

Evidence favorable to Murray's approach comes from a sophisticated study by McArthur (122). Anthropological hypotheses from F. Kluckhohn regarding upper-class and middle-class values were found to be consistent with TAT differences. Among institutionalized delinquent boys, those with more fantasy aggression indulge in more overt aggression, if punishment press is not high [Mussen & Naylor (133)]. Thus TAT does predict behavior in this acting-out group. But in leaderless groups of college students, fantasy aggression correlated with overt aggression for authoritarians (who may be regarded as fearful) and not for equalitarians (Goodrich (70)). Several correlations higher than .30 were obtained for TAT "signs of anxiety" with ratings of assessors who had projective data available [Lindzey & Newburg (110)]. Carr (26) scored character of affect expressed, determining whether different projectives implied the same emotion. Overt TAT responses agree better with sentence completions, thematic TAT scores correspond better to Rorschach, and Rorschach has little in common with sentence completion.

An unsatisfactory procedure is used by Little & Schneidman (113) to "validate" TAT [also MMPI (112)]. Twenty-nine judges provided a criterion by *Q*-sorting after studying case material on a single patient. Seventeen other judges *Q*-sorted on the basis of TAT protocols; the average correlation with the composite criterion was .60. Such correlations cannot be interpreted as validity coefficients. To validate the test as a differential instrument it must be shown that with several superficially similar cases the correlation of the sort for each man with his own criterion is consistently higher than the cross-correlations. This MMPI study has additional faults. Good procedure is shown in the highly successful attempt by Horwitz & Cartwright (89) to validate specific hypotheses about a thematic test of group behavior.

De Charms and others (43) test whether a simple questionnaire measures need achievement in the same way as McClelland's projective tests. A value for achievement score, obtained from a questionnaire, elicits different facts. The value for achievement score measures tendency to be influenced by expert opinion. Since "Yes" is the scored answer to all questions, acquiescence is a component of the score. The research provides no definitive test whether a well-designed questionnaire could duplicate projective results. Ancona (2) shows that a negativistic, critical response set is significantly associated with need for achievement.

There is little evidence that the TAT protocol, examined for formal characteristics or process variables, is of more diagnostic value than any other sample of verbal behavior. The test produces meaningful thematic information, but much more research on interpretation is required. Considerable caution is required in interpreting thematic material as a random sample of perceptions and fantasies.

*Projective techniques:* (b) *Rorschach*.—Sarason (150) offers the first major report on Rorschach which simultaneously adheres to the standards of scientific psychology and reflects faithfully the clinical use of the test. He interprets the test as purposeful problem solving; how the subject interprets both test and clinician dictates the criteria he sets for his performance and the stress or motivation he feels. Sarason collates the literature, including unpublished theses.

Validation is competently studied in programs under Sarason (94, 149, 155; see 150), Phillips (102, 115, 129, 141), and Hamlin (12, 42, 76, 136). In the Hamlin program the basic question is whether the test is best interpreted piecemeal or globally. Cummings (42) designed an adjustment scale for rating response to each card. Psychiatrists ranked adjustment on the basis of case histories; these correlated .40 to .50 with Rorschach ratings, in a wide-range sample. When Newton (136) used an identical method save that Rorschach judgments were based on the protocol as a whole, validity was negligible. Hamlin (76), considering results of his entire program, believes that the ideal unit for judging is neither the single response nor the entire protocol, but is intermediate between them.

Rather than review separate studies in inadequate space, we shall attempt to summarize the present status of Rorschach hypotheses. Scientific study of the Rorschach has barely begun but is now evidenced in studies which translate clinical theory intelligently into experimental designs and adopt proper methodology. A remarkable proportion of these attempts are successful in rejecting the null hypothesis, but failures of Rorschach hypotheses and low-level relations are frequent enough to demand revision of accepted interpretations. The following impressions are based on less-than-exhaustive consideration of the current scene, drawing heavily on Sarason and on literature of prior years along with the new studies cited.

Number of responses has uncertain significance (101) but should be controlled in making other interpretations. Approach is a meaningful vari-



able indicating the subject's way of defining the task, but scoring should distinguish effortful, integrated W's from others [Harrington (78); Lane (102); Lofchie (115); Misch (129); Phillips & Framo (141)]. Character of Dd is more important than the number. S has some relation to opposition. Form dominance as represented in M, F, FC, and other scores, compared to vague and nonform-dominant responses, reflects effort to use outer controls, and form quality reflects ability to do so [Janoff (94); Sarason (149)].

Determinant scores require much further study. No confidence can be placed in alleged color-affect relations [Baughman (8); Keehn (98); Lazarus & Oldfield (104)], and shading-anxiety relations may disappear when vagueness and form-dominance are controlled [Cox & Sarason (37)]. "Shock" phenomena may represent simply the intellectual difficulty of dealing with certain cards. There is no support for usual interpretations of FM, m, C', or separate types of shading. Hypotheses about movement or *Erlebnistyp* have hitherto been entirely unconfirmed; several studies now support inconclusively an interpretation of M as inner-directedness and introspectiveness, but not of creativeness or adjustment [Barron (6); Mann (119); Schumer (155); Singer (160)]. While those who have rejected process scoring of the Rorschach appear to be in the wrong, this does not mean that the Rorschach "is validated." It is not demonstrated that the test is precise enough or invariant enough for clinical decisions. The test has repeatedly failed as a predictor of practical criteria. For those attributes which the Rorschach taps, better projective or objective tests can no doubt be built. The Rorschach's legitimate place appears to be as a wide-band (39) instrument singling out salient aspects of the personality regarding which more data must be obtained. There is nothing in the literature to encourage reliance on Rorschach interpretations.

*Projective techniques: (c) Other.*—A manual on a Sentence Completion Blank is offered by Holsopple & Miale (85); in this form, the test is a standardized open-end interview. Rather unfavorable evidence on the Picture-Frustration Test is reported by Lindzey & Goldwyn (108) and Vane (170).

Considering all work on projectives, one is impressed by the vastly improved quality of the best available research over the best of a few years back. The most bizarre projectives are fading away, the nomothetic studies of Rorschach are forming into a coherent whole, and the TAT studies are becoming analytic and more informative. One notices, however, the absence of worth-while research on idiographic interpretation, which the clinical writers advocate as the most fruitful manner of using projectives.

#### CRITERION-ORIENTED STUDIES: PERSONALITY

To many testers, a most notable event was the publication in *Fortune* of a sharp criticism of the use of personality tests for selecting high-level employees (177). Although Whyte's criticisms are less severe than some remarks in the Buros yearbooks, the appearance of such statements in a public place disturbed many applied psychologists. The article gave insufficient



credit to those industrial psychologists who perform careful validations where they use inventories, but the fact remains that inventories of negligible validity, which penalize the person who departs from a conventional and placid self-description, are being widely applied.

Hollander (83) reviews studies of the buddy rating technique and concludes that these procedures have substantial validity as predictors of Officer Candidate School performance and similar criteria. Several improvements are suggested.

The most successful situational procedure is the leaderless group discussion. Arbous (4) reports validity as high as .60 for executive selection. Lévy-Leboyer (107) and Bass (7) review a large amount of research which shows favorable validities, analyze the nature of the test variance (see also 28), and suggest precautions in interpretation. Both of these reviews are nice examples of construct validation.

Fiske (58) points out that situation tests are useful chiefly where capacities account for little of the criterion variance. Weislogel & Schwartz (175) stress the need to elicit typical performance, to score behavior on a frequency or presence-absence basis, and to interpret records in terms of probable job success. Strangely missing from such discussions is the fact that, as was noted in connection with abilities, while "typical habits" determine how a person acts when he enters a criterion situation, he soon forms new reaction patterns which account for much variance. It is on this rock that situational measures founder unless the relevant habits are highly generalized. A similar comment applies to objective tests of temperament. The latter are omitted from this review because no encouraging studies were found.

Questionnaires have been successful in postdicting delinquency. Hanley (77) took items from the California Personality Inventory which discriminated Navy men confined for violations. Substantial separation was achieved in cross-validation. Gough (72) found that the California Psychological Inventory discriminated very adequately between delinquent and nondelinquent adults. Another remarkable empirical program is the Brown-Holtzman work on prediction of overachievement (18, 19, 86). Although this goal has eluded hundreds of investigators, with 75 Likert-type items on study attitudes they were able to obtain correlations of .50 with grades and multiple  $R$ 's of .70. The key has sufficient generality to work in many, but not all, schools. Barron (5) discusses correlates of success in graduate school, but cross-validation of these results is required.

It is an open question whether empirical MMPI scales have practical value. A previously reported scale for identifying schizophrenics is not able to differentiate adequately between these and other patients (143, 146). A scale for "sexual deviation" is made to differentiate imprisoned sex offenders from male education majors in college (120). But such a differentiation must be confounded with many variables other than sexual, and the offenders are not representative of sex deviants in general. Della Piana & Gage (45) show

that while the Minnesota Teacher Attitude Inventory predicts acceptance of teachers in classes where pupils care little about accomplishment, the test has no predictive value where pupils want to learn. Two discouraging empirical studies are reported: Tyler's attempt (169) to predict teaching success from inventories, and French's (67) on leadership. While excellent theory behind item writing may permit one to develop an empirical key on a small sample, a study without theory requires huge samples for any hope of success. Papers suggesting basic limitations of empirical use of questionnaires are presented by Moran *et al.* (132) and Rosen (144). The former show that readily available facts such as location of residence predict response to hospitalization as validly as questionnaires usually predict. Rosen shows that a valid instrument may have no value where any decision the predictor permits involves an intolerable false positive rate.

An excellent critique by Yates (180) on procedures for assessing brain damage concludes with these remarks of very general application:

A purely empirical approach is unlikely to yield satisfactory results, nor is an approach based on a theory which has not been adequately tested experimentally. A satisfactory test of brain damage should be based on a reasonable theory . . . supported by adequate statistical treatment, taking . . . into account all relevant variables. Such an approach would at least help to overcome the impasse which seems to have been reached with many of the tests reviewed. . . . While most workers in this field report satisfactory discrimination, the constant "dog eat dog" method by which one set of signs is set aside as unusable and replaced by a new set by subsequent workers does not inspire confidence in the most recent method, that of Dörken and Kral.

Sure enough, the first careful cross-validation (57) eliminates Dörken and Kral from consideration. The Piotrowski system performs with fair validity, miscalling two nonorganics out of 34, and 52 organics out of 84. This validity is encouraging, since the investigators required their instrument to discriminate organics from other neurologic patients, not from college students or other irrelevant controls.

#### CONCLUSION

Assessment research involves two perspectives, the immediate and the remote. Applied psychologists have to make decisions every day about individuals, and they cannot wait for better techniques. As researchers, however, their concern is with clarifying the nature of man and the methods of investigating him, with practical techniques only an eventual aim. The techniques and studies which count for most in one perspective mean the least in the other.

For today's applied psychologist, minimum inference is clearly best. The test which duplicates the general factor underlying the day-to-day demands of the criterion situation is a good predictor. So is a patiently developed empirical key using diverse predictors. Where such minimum-inference methods are unavailable or too costly, inferences from test to trait to pre-

dicted criterion behavior are useful provided the inferences are checked immediately and at little cost. This situation will change very slowly. Factor research is unlikely to disclose key dimensions that unlock all doors. Factors are many and hard to measure reliably. Experimental methods are showing that far more than the "content" of a test accounts for variance in score. Specific reactions developed in the criterion situation may remain stubbornly unpredictable.

Ultimate progress depends on advances in psychology, not on test engineering. Sturdy links are being forged to mediate inferences from tests to construct interpretations. But the critical inference from knowledge about the individual to practical prediction, i.e., about the relation of constructs to criterion performance, is being ignored. Harrower (79) tells us that she failed as an assessor in the Holtzman-Sells study, and her reason is illuminating. Some of the men who succeeded had test records so abnormal that she cannot believe these men functioned as good pilots. But they did. Until we understand how men function in each criterion situation, methods of assessment and guidance which demand inference cannot succeed.

## LITERATURE CITED

1. Anastasi, A., "The Measurement of Abilities," *J. Counseling Psychol.*, **1**, 164-68 (1954)
2. Ancona, L., "La C. D. motivazione al successo (need for achievement) in termini di 'response set' di acquiescenza e di negativismo," *Arch. psicol. neurol. psychiat.*, **15**, 158-66 (1954)
3. Applezweig, D. G., "Some Determinants of Behavioral Rigidity," *J. Abnormal Social Psychol.*, **49**, 224-28 (1954)
4. Arbous, A. G., *Selection for Industrial Leadership* (Oxford University Press, London, England, 180 pp., 1954)
5. Barron, F., *Personal Soundness in University Graduate Students* (University of California Press, Berkeley, Calif., 32 pp., 1954)
6. Barron, F., "Threshold for the Perception of Human Movement in Inkblots," *J. Consulting Psychol.*, **19**, 33-38 (1955)
7. Bass, B. M., "The Leaderless Group Discussion," *Psychol. Bull.*, **51**, 465-92 (1954)
8. Baughman, E. E., "A Comparative Analysis of Rorschach Forms with Altered Stimulus Characteristics," *J. Projective Techniques*, **18**, 151-64 (1954)
9. Bellak, L., *The Thematic Apperception Test and the Children's Apperception Test in Clinical Use* (Grune & Stratton, Inc., New York, N. Y., 282 pp., 1954)
10. Bennett, G. K., and Gelink, M., *Manual for Short Employment Tests* (Psychological Corporation, New York, N. Y., 11 pp., 1954)
11. Berdie, R. F., "Aptitude, Achievement, Interest, and Personality Tests: A Longitudinal Comparison," *J. Appl. Psychol.*, **39**, 103-14 (1955)
12. Bialick, I., and Hamlin, R. M., "The Clinician as Judge: Details of Procedure in Judging Projective Material," *J. Consulting Psychol.*, **18**, 239-42 (1954)
13. Biesheuvel, S., "The Measurement of Occupational Aptitudes in a Multi-Racial Society," *Occupational Psychol. (London)*, **28**, 189-96 (1954)
14. Biesheuvel, S., Jacobs, G. F., and Cowley, J. J., "Maladjustments of Military Personnel," *J. Natl. Inst. for Personnel Research*, **5**, 138-68 (1953)
15. Black, J. D., "The Use of the MMPI with Normal Persons," in *New Perspectives in Counseling*, 33-48 (Hewer, V. H., Ed., University of Minnesota Press, Minneapolis, Minn., 66 pp., 1955)
16. Brackbill, G., and Little, K. B., "MMPI Correlates of the Taylor Scale of Manifest Anxiety," *J. Consulting Psychol.*, **18**, 433-36 (1954)
17. Brogden, H. E., "A Rationale for Minimizing Distortion in Personality Questionnaire Keys," *Psychometrika*, **19**, 141-48 (1954)
18. Brown, W. F., and Holtzman, W. H., "A Study-Attitudes Questionnaire for Predicting Academic Success," *J. Educ. Psychol.*, **46**, 75-84 (1955)
19. Brown, W. F., and Holtzman, W. H., *Brown-Holtzman Survey of Study Habits and Attitudes* (Psychological Corporation, New York, N. Y., 8 pp., 1953)
20. Brozek, J., and Taylor, H. L., "Tests of Motor Functions in Investigations in Fitness," *Am. J. Psychol.*, **67**, 590-611 (1954)
21. Bruner, J. S., and Tagiuri, R., "The Perception of People," in *Handbook of Social Psychology*, 634-54 (Lindzey, G., Ed., Addison-Wesley Publishing Co., Inc., Cambridge, Mass., 2 vols., 1226 pp., 1954)
22. Burgemeister, B. B., Blum, L. H., and Lorge, I., *Columbia Mental Maturity Scale* (World Book Co., Yonkers, N. Y., 13 pp., 1954)
23. Burt, C., "The Assessment of Personality," *J. Mental Sci.*, **100**, 1-28 (1954)

24. Burt, C., "The Differentiation of Intellectual Ability," *Brit. J. Educ. Psychol.*, **24**, 76-90 (1954)
25. Buss, A. H., Wiener, M., Durkee, A., and Baer, M., "The Measurement of Anxiety in Clinical Situations," *J. Consulting Psychol.*, **19**, 125-29 (1955)
26. Carr, A. C., "Intra-Individual Consistency in Response to Tests of Varying Degrees of Ambiguity," *J. Consulting Psychol.*, **18**, 251-58 (1954)
27. Carter, G. C., "Kuder Preference Record Scores and Success in Engineering College," *J. Counseling Psychol.*, **1**, 196 (1954)
28. Carter, L. F., "Evaluating the Performance of Individuals as Members of Small Groups," *Personnel Psychol.*, **7**, 477-84 (1954)
29. Cattell, R. B., "Growing Points in Factor Analysis," *Australian J. Psychol.*, **6**, 105-40 (1954)
30. Cattell, R. B., Dubin, S. S., and Saunders, D. R., "Personality Structure in Psychotics by Factorization of Objective Clinical Tests," *J. Mental Sci.*, **100**, 154-76 (1954)
31. Cattell, R. B., Dubin, S. S., and Saunders, D. R., "Verification of Hypothesized Factors in One Hundred and Fifteen Objective Personality Test Designs," *Psychometrika*, **19**, 209-30 (1954)
32. Cattell, R. B., and Saunders, D. R., "Beiträge zur Faktoren-Analyse der Persönlichkeit," *Z. Exptl. Angew. Psychol.*, **2**, 325-57 (1954)
33. Clark, J. H., "The Interpretation of the MMPI Profiles of College Students: Mean Scores for Male and Female Groups," *J. Social Psychol.*, **40**, 319-21 (1954)
34. Clark, K. E., Gee, H. H., and Perry, D., *Measurement of Interest Patterns* (University of Minnesota, Minneapolis, Minn., 46 pp., 1953)
35. Clarke, A. D. B., and Clarke, A. M., "How Constant Is the I. Q.?", *Lancet*, **II**, 877-85 (1953)
36. Coombs, C. H., Milholland, J. E., and Womer, F. B., *The Assessment of Partial Knowledge in Objective Testing* (Engineering Research Institute, University of Michigan, Ann Arbor, Mich., 55 pp., 1955)
37. Cox, F. N., and Sarason, S. B., "Test Anxiety and Rorschach Performance," *J. Abnormal Social Psychol.*, **49**, 371-77 (1954)
38. Cronbach, L. J., "Report on a Psychometric Mission to Clinicia," *Psychometrika*, **19**, 263-70 (1954)
39. Cronbach, L. J., "The Counselor's Problems from the Perspective of Communication Theory," in *New Perspectives in Counseling*, 3-19 (Hewer, V. H., Ed., University of Minnesota Press, Minneapolis, Minn., 66 pp., 1955)
40. Cronbach, L. J., and Gleser, G. C., "Review of Stephenson, W., 'The Study of Behavior'," *Psychometrika*, **19**, 327-33 (1954)
41. Crow, W. J., *A Methodological Study of Social Perceptiveness* (Doctoral thesis, Univ. of Colorado, Boulder, Colo., 139 pp., 1954)
42. Cummings, S. T., "The Clinician as Judge: Judgments of Adjustment from Rorschach Single-Card Performance," *J. Consulting Psychol.*, **18**, 243-47 (1954)
43. De Charms, R., Morrison, H. W., and Reitman, W., *Behavioral Correlates of Directly and Indirectly Measured Achievement Motivation* (Wesleyan University, Middletown, Conn., 13 pp., 1954)
44. de Groot, A. D., "Scientific Personality Diagnosis," *Acta Psychol.*, **10**, 220-41 (1954)

45. Della Piana, G. M., and Gage, N. L., "Pupils' Values and the Validity of the Minnesota Teacher Attitude Inventory," *J. Educ. Psychol.*, **46**, 167-78 (1955)
46. Durnall, E. J., Jr., "Falsification of Interest Patterns on the Kuder Preference Record," *J. Educ. Psychol.*, **45**, 240-43 (1954)
47. Edwards, A. L., *Edwards Personal Preference Schedule* (Psychological Corporation, New York, N. Y., 18 pp., 1953)
48. Eriksen, C. W., and Davids, A., "The Meaning and Clinical Validity of the Taylor Anxiety Scale and the Hysteria-Psychasthenia Scales from the MMPI," *J. Abnormal Social Psychol.*, **50**, 135-37 (1955)
49. Eysenck, H. J., "A Dynamic Theory of Anxiety and Hysteria," *J. Mental Sci.*, **101**, 28-51 (1955)
50. Eysenck, H. J., "Abord statistique et experimental du probleme typologique dans la personnalité nevrotique, psychotique et normale," *L'Évolution Psychiat.*, **3**, 377-404 (1954)
51. Eysenck, H. J., "Probleme der diagnostischen Untersuchung und Demonstration des Charakter-Interpretationstestes," *Z. Exptl. Angew. Psychol.*, **2**, 1-32 (1954)
52. Eysenck, H. J., "Review of Stephenson, W., 'The Study of Behavior'," *J. Educ. Psychol.*, **45**, 374-76 (1954)
53. Eysenck, H. J., "Zur Theorie der Persönlichkeitsmessung," *Psychol. u. Persönlichkeitsforsch.*, **2**, 87-101, 171-87 (1954)
54. Fahmy, M., *Initial Exploring of the Shilluk Intelligence* (Dar Misr Printing House, 37A Kamel Sidky St., Cairo, Egypt, 32 pp., 1954)
55. Ferguson, G. A., "On Learning and Human Ability," *Can. J. Psychol.*, **8**, 95-112 (1954)
56. Fisher, S., and Fisher, R., "A Study of the Relationship between Personal Insecurity and One's Theoretical Orientation toward Psychological Methodology," *Am. Psychologist*, **9**, 368 (1954)
57. Fisher, J., Gonda, T. A., and Little, K. B., "The Rorschach and Central Nervous System Pathology: a Cross-Validation Study," *Am. J. Psychiat.*, **7**, 487-92 (1954)
58. Fiske, D. W., "Why Do We Use Situational Performance Tests?," *Personnel Psychol.*, **7**, 464-69 (1954)
59. Flanagan, J. C., *Flanagan Aptitude Classification Tests* (Science Research Associates, Chicago, Ill., 135 pp., 1953)
60. Fleishman, E. A., "Dimensional Analysis of Psychomotor Abilities," *J. Exptl. Psychol.*, **48**, 437-54 (1954)
61. Fleishman, E. A., and Hempel, W. E., Jr., "A Factor Analysis of Dexterity Tests," *Personnel Psychol.*, **7**, 15-32 (1954)
62. Fleishman, E. A., and Hempel, W. E., Jr., "Changes in Factor Structure of a Complex Psychomotor Test as a Function of Practice," *Psychometrika*, **19**, 239-52 (1954)
63. Fleishman, E. A., and Hempel, W. E., Jr., "Factorial Analysis of Complex Psychomotor Performance," *Research Bull. No. 54-12* (Personnel and Training Research Center, Lackland Air Force Base, San Antonio, Texas, 1954)
64. Forster, N. C., Vinacke, W. E., and Digman, J. M., "Flexibility and Rigidity in a Variety of Problem Situations," *J. Abnormal Social Psychol.*, **50**, 211-16 (1955)
65. Franks, C., *An Experimental Study of Conditioning as Related to Mental Abnormality* (Doctoral thesis, Univ. of London, London, England, 1954)

66. French, E. G., "Experimental Investigation of a Method of Measuring Achievement Motivation," *Am. Psychologist*, **9**, 371 (1954)
67. French, J. W., "The Validity of Some Objective Personality Tests for a Leadership Criterion," *Educ. Psychol. Measurement*, **14**, 34-49 (1954)
68. Fricke, B. G., *The Development of an Empirically Validated Personality Test Employing Configural Analysis for the Prediction of Academic Achievement* (Doctoral thesis, Univ. of Minnesota, Minneapolis, Minn., 1954)
69. Gleser, G. C., Haddock, J., Starr, P., and Ulett, G. A., *Psychiatric Screening of Flying Personnel: Interrater Agreement on the Basis of Psychiatric Interviews* (School of Aviation Medicine, Randolph Field, Texas, 7 pp., 1954)
70. Goodrich, D. C., "Aggression in the Projective Tests and Group Behavior of Authoritarian and Equalitarian Subjects," *Am. Psychologist*, **9**, 380 (1954)
71. Goodstein, L. D., "Regional Differences in MMPI Responses Among Male College Students," *J. Consulting Psychol.*, **18**, 437-41 (1954)
72. Gough, H. G., "Systematic Validation of a Test for Delinquency," *Am. Psychologist*, **9**, 381 (1954)
73. Guttman, L., "A New Approach to Factor Analysis: the Radex," in *Mathematical Thinking in the Social Sciences*, 258-348 (Lazarsfeld, P. F., Ed., The Free Press, Glencoe, Ill., 444 pp., 1954)
74. Haggard, E. A., "Social Status and Intelligence: An Experimental Study of Certain Cultural Determinants of Measured Intelligence," *Genet. Psychol. Monographs*, **49**, 141-86 (1954)
75. Halbower, C. C., *A Comparison of Actuarial versus Clinical Prediction to Classes Discriminated by MMPI* (Doctoral thesis, Univ. of Minnesota, Minneapolis, Minn., 1955)
76. Hamlin, R. M., "The Clinician as Judge: Implications of a Series of Studies," *J. Consulting Psychol.*, **18**, 233-38 (1954)
77. Hanley, C., *An Inventory of Personal Opinions* (U. S. Naval Retraining Command, San Diego, Calif., 17 pp., 1954)
78. Harrington, R. W., "Maladaptive Responses to Frustration Predicted from Rorschach Color Responses," *J. Consulting Psychol.*, **18**, 455-58 (1954)
79. Harrower, M., "Clinical Aspects of Failures in the Projective Techniques," *J. Projective Techniques*, **18**, 294-302 (1954)
80. Heim, A. W., "Les conventions de base des tests d'intelligence," *Enfance*, **7**, 105-12 (1954)
81. Hempel, W. E., Jr., and Fleishman, E. A., "A Factor Analysis of Physical Proficiency and Manipulative Skill," *J. Appl. Psychol.*, **39**, 12-16 (1955)
82. Hofstaetter, P. R., "The Changing Composition of 'Intelligence'; A Study in T-Technique," *J. Genet. Psychol.*, **85**, 159-64 (1954)
83. Hollander, E. P., "Buddy Ratings: Military Research and Industrial Implications," *Personnel Psychol.*, **7**, 385-93 (1954)
84. Holloway, H. D., "Effects of Training on the SRA Primary Mental Abilities (Primary) and the WISC," *Child Development*, **25**, 253-63 (1954)
85. Holsopple, J. Q., and Miale, E. R., *Sentence Completion, A Projective Method for the Study of Personality* (Charles C Thomas, Springfield, Ill., 177 pp., 1954)
86. Holtzman, W. H., Brown, W. F., and Farquhar, W. G., "The Survey of Study Habits and Attitudes: a New Instrument for the Prediction of Academic Success," *Educ. Psychol. Measurement*, **14**, 726-32 (1954)



87. Holtzman, W. H., and Sells, S. B., "Prediction of Flying Success by Clinical Analysis of Test Protocols," *J. Abnormal Social Psychol.*, **49**, 485-90 (1954)
88. Holzinger, K. J., and Crowder, N. A., *Holzinger-Crowder Uni-Factor Tests* (World Book Company, Yonkers, N. Y., 28 pp., 1955)
89. Horwitz, M., and Cartwright, D., "A Projective Method for the Diagnosis of Group Properties," *Human Relations*, **6**, 397-410 (1953)
90. Husén, T., "La validité des interviews par rapport à l'âge, au sexe et à la formation des interviewés," *Trav. Humain*, **17**, 60-67 (1954)
91. Husén, T., "Über die Begabung von Zwillingen," *Psychol. Beiträge*, **1**, 137-45 (1953)
92. Hurtig, M., "Recherche sur la perfectibilité," *Enfance*, **7**, 317-26 (1954)
93. Hutt, M. L., "Toward an Understanding of Projective Testing," *J. Projective Techniques*, **18**, 197-201 (1954)
94. Janoff, I. Z., *The Relation between Rorschach Form Quality Measures and Children's Behavior* (Doctoral thesis, Yale Univ., New Haven, Conn., 1951)
95. Jensen, M. B., and Schmid, J., "An Analysis of Some Clinical Judgments on Male Basic Airmen Who Failed the Group Psychological Tests," *J. Clin. Psychol.*, **10**, 325-32 (1954)
96. Jones, E. E., "Authoritarianism as a Determinant of First-Impression Formation," *J. Personality*, **23**, 107-27 (1954)
97. Kabrick, R. P., *Predictive Value of a Revised Forced Choice Form of the Manifest Anxiety Scale* (Iowa State University, Iowa City, Iowa, 25 pp., 1954)
98. Keehn, J. D., "A Re-interpretation of the Role Played by Color in the Rorschach Test," *Brit. J. Med. Psychol.*, **27**, 89-93 (1954)
99. Kelly, E. L., "The Place of Situation Tests in Evaluating Clinical Psychologists," *Personnel Psychol.*, **7**, 484-92 (1954)
100. Kelly, G. A., *The Psychology of Personal Constructs. I. A Theory of Personality* (W. W. Norton and Co., New York, N. Y., 556 pp., 1955)
101. Kornetsky, C., and Gerard, D. L., "Effect of Increasing the Number of Rorschach Responses on Sum C and M: A Note on Fiske and Baughman's Study," *J. Abnormal Social Psychol.*, **49**, 592-93 (1954)
102. Lane, J. R., "Social Effectiveness and Developmental Level," *J. Personality*, **23**, 274-83 (1955)
103. Layton, W. L., "Theory and Research on the Strong Vocational Interest Blank: A Conference Report," *J. Counseling Psychol.*, **2**, 10-12 (1955)
104. Lazarus, R. S., and Oldfield, M., "Rorschach Responses and the Influence of Color," *J. Personality*, **23**, 356-72 (1955)
105. Léon, A., "Quelques remarques sur les apports des dernières rencontres de psychologues," *Enfance*, **7**, 381-92 (1954)
106. Levitt, E. E., "Studies in Intolerance of Ambiguity: I. The Decision-Location Test with Grade School Children," *Child Development*, **24**, 263-68 (1953)
107. Lévy-Leboyer, C., "Les tests de groupe," *Trav. Humain*, **18**, 17-39 (1955)
108. Lindzey, G., and Goldwyn, R. M., "Validity of the Rosenzweig Picture-Frustration Study," *J. Personality*, **22**, 519-47 (1954)
109. Lindzey, G., and Herman, P. S., "Thematic Apperception Test: A Note on Reliability and Situational Validity," *J. Projective Techniques*, **19**, 36-42 (1955)
110. Lindzey, G., and Newburg, A. S., "Thematic Apperception Test: A Tentative Appraisal of Some 'Signs' of Anxiety," *J. Consulting Psychol.*, **18**, 389-95 (1954)

111. Lipsett, L., and Wilson, J. W., "Do 'Suitable' Interests and Mental Ability Lead to Job Satisfaction?," *Educ. Psychol. Measurement*, **14**, 373-80 (1954)
112. Little, K. B., and Shneidman, E. S., "The Validity of MMPI Interpretations," *J. Consulting Psychol.*, **18**, 425-28 (1954)
113. Little, K. B., and Shneidman, E. S., "The Validity of Thematic Projective Technique Interpretations," *J. Personality*, **23**, 285-94 (1955)
114. Loevinger, J., "Some Principles of Personality Measurement," *Educ. Psychol. Measurement*, **15**, 3-17 (1955)
115. Lofchie, S. H., "The Performance of Adults under Distraction Stress: A Developmental Approach," *J. Psychol.*, **39**, 109-16 (1955)
116. Lorge, I., and Thorndike, R. L., *Lorge-Thorndike Intelligence Tests* (Houghton Mifflin Co., Boston, Mass., 9 pp., 1955)
117. Luborsky, L., "Selecting Psychiatric Residents: Survey of the Topeka Research," *Bull. Menninger Clinic*, **18**, 252-59 (1954)
118. Mackie, R. R., Strayer, F. K., and Buckner, D. N., *Validation of the U. S. Medical Research Laboratory Personnel Assessments* (Management and Marketing Research Corp., Los Angeles, Calif., 43 pp., 1954)
119. Mann, L., *The Relation of Rorschach Indices of Extratension and Introversion to a Measure of Responsiveness to the Immediate Environment* (Doctoral thesis, Univ. of North Carolina, Chapel Hill, N. C., 1953)
120. Marsh, J. T., Hilliard, J., and Liechti, R., "A Sexual Deviation Scale for the MMPI," *J. Consulting Psychol.*, **19**, 55-59 (1955)
121. McArthur, C., "Analyzing the Clinical Process," *J. Counseling Psychol.*, **1**, 203-7 (1954)
122. McArthur, C., "Personality Differences between Middle and Upper Classes," *J. Abnormal Social Psychol.*, **50**, 247-54 (1955)
123. McIntyre, C. J., "Sex, Age, and Iconicity as Factors in Projective Film Tests," *J. Consulting Psychol.*, **18**, 337-43 (1954)
124. Meehl, P. E., *Clinical vs. Statistical Prediction* (Univ. of Minnesota Press, Minneapolis, Minn., 149 pp., 1954)
125. Meili, R., "Ein Zerrbild der Test-Psychologie," *Psychol. Rundschau*, **5**, 81-86 (1954)
126. Melton, R. S., *A Comparison of Clinical and Actuarial Methods of Prediction with an Assessment of the Relative Accuracy of Different Clinicians* (Doctoral thesis, Univ. of Minnesota, Minneapolis, Minn., 124 pp., 1952)
127. Meyer, M. M., and Tolman, R. S., "Correspondence between Attitudes and Images of Parental Figures in TAT stories and in Therapeutic Interviews," *J. Consulting Psychol.*, **19**, 79-82 (1955)
128. Milam, J. R., "Examiner Influences on Thematic Apperception Test Stories," *J. Projective Techniques*, **18**, 221-26 (1954)
129. Misch, R. C., *The Relationship of Motoric Inhibition to Developmental Level and Ideational Functioning* (Doctoral thesis, Clark Univ., Worcester, Mass., 1953)
130. Mitzel, H. E., Rabinowitz, W., and Ostreicher, L. M., *Effect of Certain Response Sets on Valid Test Variance* (Division of Teacher Education, College of the City of New York, New York, N. Y., 23 pp., 1955)
131. Mooney, C. M., "A Factorial Study of Closure," *Can. J. Psychol.*, **8**, 51-60 (1954)
132. Moran, L. J., Fairweather, G. W., Morton, R. B., and McGaughan, L. S., "The Use of Demographic Characteristics in Predicting Response to Hospitalization for Tuberculosis," *J. Consulting Psychol.*, **19**, 65-70 (1955)

133. Mussen, P. H., and Naylor, H. K., "The Relationships between Overt and Fantasy Aggression," *J. Abnormal Social Psychol.*, **49**, 235-40 (1954)
134. Mussen, P. H., and Scodel, A., "The Effects of Sexual Stimulation under Varying Conditions on TAT Sexual Responsiveness," *J. Consulting Psychol.*, **19**, 90-91 (1955)
135. Navran, L., and Stauffacher, J. C., "Social Desirability as a Factor in Edwards Personality Preference Schedule Performance," *J. Consulting Psychol.*, **18**, 442 (1954)
136. Newton, R. L., "The Clinician as Judge: Total Rorschachs and Clinical Case Material," *J. Consulting Psychol.*, **18**, 248-50 (1954)
137. O'Neil, W. M., and Levinson, D. J., "A Factorial Exploration of Authoritarianism and Some of its Ideological Concomitants," *J. Personality*, **22**, 449-63 (1954)
138. Osburn, H. G., Lubin, A., Loeffler, J. C., and Tye, V. M., "The Relative Validity of Forced Choice and Single Stimulus Self Description Items," *Educ. Psychol. Measurement*, **14**, 407-17 (1954)
139. Osgood, C. E., and Luria, Z., "A Blind Analysis of a Case of Multiple Personality Using the Semantic Differential," *J. Abnormal Social Psychol.*, **49**, 579-91 (1954)
140. Parrish, J., and Rethlingshafer, D., "A Study of the Need to Achieve in College Achievers and Non-Achievers," *J. Gen. Psychol.*, **50**, 209-26 (1954)
141. Phillips, L., and Framo, J. L., "Developmental Theory Applied to Normal and Psychopathological Perception," *J. Personality*, **22**, 464-74 (1954)
142. Porteus, S. D., "Maze Test Qualitative Aspects," *Brit. J. Med. Psychol.*, **27**, 72-79 (1954)
143. Quay, H., and Rowell, J. T., "The Validity of a Schizophrenic Screening Scale of the MMPI," *J. Clin. Psychol.*, **11**, 92-93 (1955)
144. Rosen, A., "Detection of Suicidal Patients: An Example of Some Limitations in the Prediction of Infrequent Events," *J. Consulting Psychol.*, **18**, 397-404 (1954)
145. Rosenwald, A. K., "An Assessment of the Current Role of Psychodiagnostic Testing," *J. Consulting Psychol.*, **18**, 311-15 (1954)
146. Rubin, H., "Validity of a Critical-Item Scale for Schizophrenia on the MMPI," *J. Consulting Psychol.*, **18**, 219-20 (1954)
147. Rulon, P. J., and Schweiker, R. F., *Validation of a Non-Verbal Test of Military Trainability. The Semantic Test of Intelligence* (Harvard University, Cambridge, Mass., 49 pp., 1953)
148. Sampson, H., and Bindra, D., "'Manifest' Anxiety, Neurotic Anxiety, and the Rate of Conditioning," *J. Abnormal Social Psychol.*, **49**, 256-59 (1954)
149. Sarason, E. K., *The Discriminatory Value of the Rorschach Test Between Two Etiologically Different, Mentally Defective Groups* (Doctoral thesis, Clark Univ., Worcester, Mass., 1950)
150. Sarason, S. B., *The Clinical Interaction, with Special Reference to the Rorschach* (Harper & Brothers, New York, N. Y., 425 pp., 1954)
151. Saunders, D. R., *A Factor Analysis of Some Personality Items in a Domain of Social Identification* (Educational Testing Service, Princeton, N. J., 15 pp., 1954)
152. Schafer, R., *Psychoanalytic Interpretation in Rorschach Testing* (Grune & Stratton, Inc., New York, N. Y., 446 pp., 1954)

153. Scheier, I. H., "An Evaluation of Rigidity Factors," *Can. J. Psychol.*, **8**, 157-63 (1954)
154. Schmidt, H. O., Fonda, C. P., and Wesley, E. L., "A Note on Consistency of Rigidity as a Personality Variable," *J. Consulting Psychol.*, **18**, 450 (1954)
155. Schumer, F. C., *Some Behavioral Correlates of Rorschach Human Movement Responses* (Doctoral thesis, Yale Univ., New Haven, Conn., 1949)
156. Secord, P. F., "'Personality Integration' in Responses to Self-Inventories," *J. Personality*, **23**, 308-16 (1955)
157. Segel, D., and Raskin, E., *Multiple Aptitude Tests* (California Test Bureau, Los Angeles, Calif., 1955)
158. Siegel, S., "Certain Determinants and Correlates of Authoritarianism," *Genet. Psychol. Monographs*, **49**, 187-229 (1954)
159. Simoneit, M., "Zur Kritik der Test-Psychologie," *Psychol. Rundschau*, **5**, 44-80 (1954)
160. Singer, J. L., and Herman, J., "Motor and Fantasy Correlates of Rorschach Human Movement," *J. Consulting Psychol.*, **18**, 325-31 (1954)
161. Stein, M. I., *The Thematic Apperception Test, Revised Edition* (Addison-Wesley Publishing Co., Inc., Cambridge, Mass., 365 pp., 1955)
162. Steiner, I. D., "Ethnocentrism and Tolerance of Trait 'Inconsistency,'" *J. Abnormal Social Psychol.*, **49**, 349-54 (1954)
163. Stephenson, W., *The Study of Behavior* (University of Chicago Press, Chicago, Ill., 376 pp., 1953)
164. Symonds, P. M., "Are Projective Test Data Valid Bases for Prediction?," *J. Projective Techniques*, **18**, 515-19 (1954)
165. Terman, L. M., "The Discovery and Encouragement of Exceptional Talent," *Am. Psychologist*, **9**, 221-30 (1954)
166. Thurstone, L. L., and Thurstone, T. G., *Examiner Manual for the SRA Primary Mental Abilities, Ages 7 to 11*, 2nd ed. (Science Research Associates, Chicago, Ill., 21 pp., 1954)
167. Tiedeman, D. V., and Bryan, J. G., "Prediction of College Field of Concentration," *Harvard Educ. Rev.*, **24**, 122-39 (1954)
168. Tiffin, J., and Lawshe, C. H., *Examiner Manual for the Adaptability Test* (Science Research Associates, Chicago, Ill., 6 pp., 1954)
169. Tyler, F. T., *The Prediction of Student-Teaching Success from Personality Inventories* (University of California Press, Berkeley, Calif., 81 pp., 1954)
170. Vane, J. R., "Implications of the Performance of Delinquent Girls on the Rosenzweig Picture-Frustration Study," *J. Consulting Psychol.*, **18**, 414 (1954)
171. Vernon, P. E., "Symposium on the Effect of Coaching and Practice on Intelligence Tests. V. Conclusions," *Brit. J. Educ. Psychol.*, **24**, 57-63 (1954)
172. Walker, W. B., *An Investigation of the Effectiveness of Communication between Psychologists and Sales Executives Through Personnel Audit Reports* (Doctoral thesis, Western Reserve Univ., Cleveland, Ohio, 209 pp., 1955)
173. Wand, B., and Mollenkopf, W. G., *Selection and Classification Tests for Women* (Educational Testing Service, Princeton, N. J., 64 pp., 1954)
174. Wechsler, D., *Wechsler Adult Intelligence Scale Manual* (Psychological Corporation, New York, N. Y., 110 pp., 1955)
175. Weislogel, R. L., and Schwartz, P. A., "Some Practical and Theoretical Problems in Situational Testing," *Educ. Psychol. Measurement*, **15**, 39-46 (1955)

176. Wertheimer, M., "The Differential Satiability of Schizophrenic and Normal Subjects: A Test of a Deduction from the Theory of Figural After-Effects," *J. Gen. Psychol.*, **51**, 291-99 (1954)
177. Whyte, W. H., Jr., "The Fallacies of 'Personality' Testing," *Fortune*, **50**, 117-21 (1954)
178. Wilson, J. W., "Correlation of Clinical Estimates with Test Scores on Mental Ability and Personality Tests," *J. Clin. Psychol.*, **10**, 97-99 (1954)
179. Wolking, W. D., "Predicting Academic Achievement with the Differential Aptitude and the Primary Mental Abilities Tests," *J. Appl. Psychol.*, **39**, 115-18 (1955)
180. Yates, A. J., "The Validity of Some Psychological Tests of Brain Damage," *Psychol. Bull.*, **51**, 359-79 (1954)
181. Zimmerman, W. S., "The Influence of Item Complexity upon the Factor Composition of a Spatial Visualization Test," *Educ. Psychol. Measurement*, **14**, 106-19 (1954)
182. Zubin, J., "The Measurement of Personality," *J. Counseling Psychol.*, **1**, 159-64 (1954)
183. Zubin, J., "Failures of the Rorschach Technique," *J. Projective Techniques*, **18**, 303-15 (1954)
184. Zubin, J., "Presidential Address—Biometric Methods in Psychopathology," *Proc. Am. Psychopathol. Assoc.*, **9**, 123-43 (1954)

# INDUSTRIAL PSYCHOLOGY<sup>1,2</sup>

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## INTRODUCTION

During the past year, as in each year since World War II, there has been a vast amount of published material dealing with the "people" problems of industry. This can be observed in the scientific literature as well as in general business and trade publications. However, if a quality criterion is employed, the output is relatively small. Probably less than 10 per cent of the material which crosses the desk of the psychologist working in industry can be classified as technical research reports. Neither psychologists nor business men would have suffered serious loss if as much as half of the total volume had not been printed. The remaining portion consisting of diverse papers, such as critical evaluations of the literature, theoretical expositions, textbooks and reprinted speeches may serve a useful purpose as a communications medium between psychologists concerned with industrial applications.

The change in the nature and scope of the work of the industrial or personnel psychologist is beginning to be reflected in reports appearing in the literature. Once viewed as a test technician occasionally helpful to the employment department, he is now being called upon by management to aid in solving a variety of problems involving individuals and groups. He works and publishes, at least for internal company or client use, in areas formerly considered the exclusive domain of such specialists as the labor economist, the sociologist, the time and methods engineer, the industrial designer, and the industrial relations manager. These specialists, in turn, are also working in fields to which psychologists lay claim.

The industrial psychologist draws on the various branches of scientific psychology for the principles and practices which he seeks to apply in the specific industrial setting in which he works. His research, therefore, may be limited to studies of the feasibility of using laboratory developed methods in dealing with company problems. Little of his work will be basic research. Since he works in a staff relationship with little or no control over people or conditions, seldom does he have an opportunity to attack problems in a rigorous manner. Criteria, sample size, and experimental conditions are troublesome.

Unless subject matter is restricted to employee selection, and no one seems inclined to take such a step, industrial psychology, as it is presently developing, does not represent a unified technical-scientific specialty. And

<sup>1</sup> The survey of the literature pertaining to this review was completed in May, 1955.

<sup>2</sup> The following abbreviations are used in this chapter: NICB (National Industrial Conference Board); SVIB (Strong Vocational Interest Blank).

except for a statistical, psychometric orientation, there is little to distinguish the industrial psychologist from other social scientists working in industry.

Against this background, an integrative, evaluative review of the literature dealing with industrial applications must wait for some future reviewer. In the meantime, this review summarizes the current literature as it appears in professional journals. Reports from other than standard psychological journals have been introduced which contribute to an understanding of the current status of a specific problem.

#### NEW BOOKS

A collection of 16 essays dealing with current thinking and research on manpower problems and policies has been published by the Industrial Relations Research Association under the title *Manpower in the United States* (62). In their introduction the editors state as one objective of public policy with respect to manpower in the United States: "To utilize the labor force efficiently through proper matching of jobs with people, effective management, and the appropriate education, training, and development of people. . . ." Psychologists Likert and Seashore were allotted one brief chapter to summarize psychological contributions to solution of problems of utilization. Although they have done a good job in a short space, a second chapter giving greater detail on selection, classification, and training would have been a valuable addition. Barkin, a trade unionist, contributed the chapter on job redesign which will be of particular interest as a statement of current trade union thinking and a forecast of eventual demands. In passing, it might be noted that although individuals with academic, government, and union affiliations are represented among the contributors, no industry spokesman was included. This has been true in previous Industrial Relations Research Association publications.

Reference to Stryker's (130) *A Guide to Modern Management Methods* is made because it contains extracts from widely read *Fortune* magazine articles dealing with such topics as executive development, testing, and employee communications. While the degree to which *Fortune* and other business and trade publications influence the thinking and attitudes of American businessmen and business managers may be open to debate, the industrial psychologist can profit from the discussions of and reactions to his work as they appear in these business publications.

Several well-known textbooks have appeared in revised editions. Scott, Clothier & Spriegel's *Personnel Management* (120) features a four chapter section on the use of psychology in personnel administration. The first of these chapters is a historical summary of the first 50 years of applied psychology. The authors' view of the role of the industrial psychologist is given in the last sentence of this chapter: "Psychologists will continue to work at the fundamental problem of improving tests and other devices for appraising personnel, but their growing participation in attacking a broader range of



problems in human relations may also be anticipated." The remaining three chapters in this section are devoted to test types and the uses of tests. Other topics commonly found in texts on industrial psychology are treated as the subject matter of personnel management by these authors.

Bellows (19) in the 2nd edition of his *Psychology in Business and Industry* has organized his book into 19 chapters, only one of which deals with personnel testing. His chapters on job evaluation, wage incentives, and recruiting, for example, are all informative and well written. Two new chapters dealing with dynamics of the work group add greatly to the value of the text. Ghiselli & Brown (51) in the 2nd edition of their *Personnel and Industrial Psychology* also reflect the growing trend away from emphasis on tests and selection methods which heretofore has occupied the attention of textbook writers in industrial psychology. Although some of the sections dealing with traditional topics are relatively unchanged, they do introduce much new material on social and environmental factors which are important in the work situation.

Without in any way detracting from the textbooks named here, there are two general criticisms to be made of industrial psychology texts. In the opinion of this reviewer industrial psychology texts and classroom discussions in industrial psychology courses tend to overemphasize activities which concern the rank-and-file worker. Topics such as job description, job evaluation, and employment testing may occupy a major part at the expense of an adequate presentation of the effect of the organization structure and the organizational atmosphere on the company and its personnel. The psychologist working in industry soon discovers that many employee problems are symptomatic, reflecting management and supervisory attitudes and behavior. For the industrial psychologist to be effective it may be necessary, initially, for him to concentrate his attention on the management group. After he has been accepted by this group and gained insights into management people and their problems as they view them, he may begin to accomplish something at the employee level. But how to become effective in an organization is a subject that has been avoided in most texts.

A related criticism concerns the inclusion in some industrial psychology texts of material usually taught in industrial engineering or business management courses. The industrial psychologist should be familiar with wage incentive plans, job evaluation schemes, and rating techniques, for example, because he may be called upon to evaluate these plans and their effects on employees. In practice, however, most work in personnel administration is performed by individuals who are not trained as psychologists. In many companies, employment interviewing and test administration are viewed as clerical tasks under the administrative supervision of the employment manager. The industrial psychologist will have only a staff-advisory relationship to this group. Proper balance in a text, in the opinion of this reviewer, requires that personnel management topics be treated in somewhat less detail than subjects of a more specialized or technical nature.

## CRITERIA OF PERFORMANCE

Wallace & Weitz (137) devoted almost one-third of their chapter on Industrial Psychology in the 1955 *Annual Review of Psychology* to a discussion of criteria and the state of research on the criterion problem. Their conclusion, "the pressure of getting things done is still wooing many into the convenient device of accepting the criterion at hand and hoping it will turn out all right," applies equally to the literature covered in this review.

The bulk of the work on criteria, particularly on rating methods, has been done by investigators working in or for one or another of the military services. One comprehensive study of rating methodology is reported by Bayroff, Haggerty & Rundquist (17). This study was designed to determine the effect on validity of different types of rating techniques, of a number of rater characteristics, and of conditions under which ratings were collected and used. Of particular importance were these findings: (a) raters who scored high on certain variables, e.g., Officer Classification Test score, produced more valid ratings than those who scored low on these variables; (b) the rater was more important than the rating technique, the larger the number of competent raters used, the greater the validity.

Wherry, Campbell & Perloff (139) investigated factors involved in ratings of Army officer efficiency. A total of 17 variables from check list, forced-choice, and graphic ratings by superiors and graphic ratings by associates were factor analyzed. Of more interest than the eight factors extracted is the authors' discussion of possible sources of contamination in the basic data through rater bias and halo.

Research on the use of peer ratings, that is, ratings of an individual by members of a group in which he is an active member, has been summarized by Hollander (73). He concludes that this form of rating has potential as an assessment device. Hollander (74) also has reported an investigation of the relationship between peer nominations on leadership obtained during pre-flight school with success or failure through the whole of flight training. The ratings of 268 cadets were obtained at the end of three months of preflight training. The leadership score derived from this rating correlated .27 with the pass-fail flight criterion determined 18 months later. Hollander suggests that the observed relationship may be attributed to facets of the individual perceived and reacted to by both peer raters and by those who evaluate performance in flight training.

Webb (138) was concerned that requests for negative nominations might have undesirable results. Peer ratings on leadership (117 cases) were obtained in the usual fashion. A biserial correlation between the algebraic sum of ratings and a dichotomy based on receiving or not receiving a positive nomination was computed to be +.87. Webb suggests that in certain situations it may be more feasible to use only positive nominations.

Cozan (34) in an investigation of ratings of specific aspects of a job versus over-all ratings of job proficiency compared ratings of 40 cafeteria employees by their two immediate supervisors. Initial ratings made on

specific aspects correlated .43. On over-all performance the coefficient was .59. When ratings were again obtained three weeks later, these coefficients were .80 and .60 respectively. Cozan reported the correlations between the two sets of ratings to be .67 and .78 for rater A and .81 and .85 for rater B. On the basis of these data he concludes that there is no significant difference in the reliability of the two methods. At best, studies of this kind should be considered as suggestive rather than conclusive. Findings based on a small sample and two inexperienced raters need further verification before publication.

Some of the problems encountered in rating for performance evaluation are discussed by Glickman (55). In his paper he is particularly concerned with what ratings do to people. His example, taken from military fitness reports, suggests that with the extreme negative skewness characteristic of these ratings a "mistake" receives disproportionate weight. He believes that this can lead to a premium on conformity in an organization with a resulting loss to the organization of individuals capable of accepting new responsibilities or willing to try new ways.

Spector (125) has reported a novel study in which he investigated the influence on ratings of amenability to suggestions and the rater's opportunity to make suggestions to the ratee. A carefully trained lecturer posing as a student interested in becoming a teacher presented the same, poorly delivered lecture to five sections in a General Psychology course. Students were asked to evaluate his teaching ability after the lecture by rating manner, ability, knowledge, potential, and poise. Three groups (A, B, C) submitted written suggestions for improvement after the first 15 minutes. In group A the suggestions were accepted although no changes were made, in group B they were rejected, and in group C they were not submitted to the lecturer until the end of the lecture. Groups D and E were not given an opportunity to make suggestions. The acceptance group, A, recorded the most favorable ratings on each of the five factors. Groups B and C gave more favorable ratings than groups D and E, but were substantially below group A. Spector suggests that ratings on manner, knowledge, poise, and potential may reflect personal frames of reference and, therefore, be more readily influenced by extraneous factors. In the industrial setting where rating scales often include factors such as promotability and quality of work, the influence of irrelevant behaviors of the ratee may be considerable.

Taylor, Schneider & Clay (132) described the development of a series of short forced-choice scales to be used as a criterion against which a test battery was to be validated. In their search for an objective criterion for validation of the forced-choice scale they encountered the usual problems. Their solution was the "adjusted objective" evaluation procedure which involves identification by management of important indices of a successful operation. Since this study was of retail store managers, these elements included indices such as gross sales, net profit, personnel turnover, and credit loss. Store managers were then ranked by their district managers

(second level above) on each of the criterion elements. These rankings were combined in a single over-all criterion. Validities for the 10 subscales (10 items each) of forced-choice items and for the total scale (28 items) ranged from .51 to .62. This study illustrates very clearly the extent to which the industrial psychologist must go in order to obtain criterion data. The findings, when test scores are validated against the "adjusted objective" criterion and the forced-choice scales, should be of interest.

The weakness in most executive and management development programs, according to Mahler & Frazier (92), lies in appraisal or evaluation of performance. Commonly, some kind of trait-rating is employed. The number of traits may vary from 6 to 20, averaging about 10. Another approach is the use of general factors such as qualifications, potential, or results appraised in narrative form. The authors are critical of these plans because of restricted application, lack of pertinence, and the emphasis on traits rather than on results. They recommend a three-stage program beginning with the development of a responsibility check-list for each job as a basic evaluative tool. The superior then rates the subordinate on each of the check-list items. As a second step a statement of evidence is prepared for use in appraising each responsibility. Mahler & Frazier view this as an important step since it forces consideration of actual goals. The third stage requires development of actual performance standards which can be used with the responsibility check-list and the statement of evidence. As the authors point out, appraising performance against established standards is a different matter. Results are either up to standard or not.

In his description of the appraisal program used by one department of the General Electric Company, Kellogg (80) outlines reasons for abandoning their trait-rating form and replacing it with a "responsibility appraisal method." The responsibility summary which is the key to the plan consists of the 10 to 15 responsibilities most important for fulfilling the job. This summary is jointly prepared by the ratee, the rater, and the rater's superior. Each responsibility is weighted to reflect the relative importance attached to it by the immediate supervisor. In making the appraisal employee performance is evaluated against the specific statements of the responsibility summary by checking one of six points ranging from "fails to meet requirements" to "far exceeds normal expectations." Evidence or critical incidents to support the rating are required. Kellogg reports that attitude survey items dealing with the plan indicate acceptance and approval by management personnel.

The real test of any rating plan must, of course, await further experience with the plan. Kellogg's paper emphasizes the need for management acceptance of the need for a plan as well as of the plan, itself. One potential source of trouble is the use of an appraisal plan designed for developmental purposes as a guide for compensation purposes. The supervisor seeking salary increases for his subordinates may fail to be as critical as he should. Perhaps inability to control the rating in this way accounts for the lack of popularity of forced-choice methods in industry.

No review of validity or criterion studies would be complete without mention of Langmuir's (85) amusing and enlightening presentation of the problem of cross-validation. The purpose of cross-validation, he reminds us, is "to protect us from being fooled into putting confidence in a relationship which *happens* to hold true for the group we started with, but which will let us down in the long run." We get this protection only when a decision from one set of data is applied successfully to another independent, but relevant, sample of people.

#### SELECTION

*General.*—Several surveys of the frequency of use of various methods in the selection process have been reported. The interview and the application blank are still the favored methods. Scott, Clothier & Spriegel (120) in their report on personnel management in 628 selected companies (in 1953) find a marked increase in the use of stenographic tests, trade tests, and intelligence tests since their previous survey (1947). Of the reporting companies, 75 per cent use tests in selection, 73 per cent use clerical or stenographic tests, and 56 per cent mental or intelligence tests. These findings are not confirmed by the 1954 National Industrial Conference Board Study of Personnel Practices (121). With a somewhat smaller sample (515 companies) the NICB reports that only 32 per cent of reporting firms use tests with hourly workers. In the case of salaried employees, however, 43 per cent report using tests. Another set on data is reported by Steele, Myles & McIntyre (127) in a study of the impact of unionism on personnel practices in the Southeastern United States. Although the differences between the data of these studies are statistically significant, the practical importance is questionable. Unless a management operates solely on a follow-the-leader basis, detailed reports based on surveys of personnel methods are of only passing interest.

Of value to the personnel manager and the industrial psychologist is the summary of industrial recruitment and selection practices given by Habbe (61). Although he emphasizes how-to-do-it aspects, he does direct attention to the need for research validation within the company before any technique can be adopted. Another side of the picture is given in Lester's (87) study of the Trenton, New Jersey, labor market. Of the 82 manufacturing companies studied, only 12 had more than 1000 employees. In 22 companies there were less than 200 employees. Lester found little evidence of the use of psychological principles or practices in recruitment, hiring, and selection of employees. Recruitment was through the existing work force or at the gate. Generally, new employees were hired only for entrance positions. Selection was based on a personal interview. Promotion was from within the ranks on a seniority basis. Malm's (93) study of employment practices in the San Francisco area gives a picture somewhat similar to that reported by Lester. Although hiring standards may vary as a function of the tightness of the local labor market, the "warm body" criterion is probably far more common than indicated in personnel management textbooks or personnel practices surveys. If the industrial psychologist has a real contribution to make toward greater

company efficiency and increased worker satisfaction through selection, classification, and induction procedures an area such as Trenton or San Francisco might be an ideal place for a demonstration of this contribution.

Meehl (102) has written what may prove to be the most discussed book of the year, *Clinical vs. Statistical Prediction*. He has attempted a theoretical analysis and a review of the meager evidence bearing on the relative efficiency of clinical and actuarial predictions of behavior. Although Meehl is oriented toward and draws his examples from psychopathology, the issues treated are of vital importance to the industrial psychologist. It should be understood that Meehl is not dealing with the kind-of-data dimension, but rather with actuarial versus nonactuarial methods of combining data for predictive purposes.

In companies using employment tests, the usual practice is to prepare a folder containing test scores, the application blank, interview notes, results of reference checks, and any other relevant data for the use of the interviewer in making his recommendation to the employing supervisor. Based on Meehl's conclusions, it is possible that the "clinical," that is, nonstatistical combination of test scores and other data by the interviewer, many actually lower the predictive efficiency of the various selective devices employed.

Since the publication of Meehl's book, the Holtzman & Sells (75) study has appeared. The authors, as part of a larger investigation of adjustment to military and combat flying, considered two questions: (a) Can expert clinical psychologists, given a description of the problem and a definition of the criterion, predict this criterion on the basis of a battery of personality tests? (b) If such predictions can be made successfully, what are the predictor signs used and how are they integrated to obtain successful predictions? Personality test protocols for 100 aviation cadets were used. Fifty of the cadets had made a highly successful adjustment to flight training stresses. Fifty had been eliminated from the program because of overt personality disturbances. Nineteen expert clinicians participated in the study. Each clinician judged 20 test protocols, pass or fail, and indicated the degree of confidence in his judgment on a three point scale. Four groups (20 protocols each) were judged by three clinicians. One group (20 protocols) was judged by seven clinicians. The number of correct global judgments among the 19 psychologists ranged from 4 to 14 with a mean of 10.2. The expected chance number of correct predictions for a single judge is 10. The authors note that the predictions of one psychologist were worse than chance! Although no actuarial predictions are reported it is reasonable to assume that a statistical combination of the test scores would have resulted in better prediction at lower cost in a shorter time.

Another issue with important implications for selection procedure, but usually overlooked, is dealt with by Taft (131) in his review of the literature concerning the ability to judge accurately behavioral characteristics, such as abilities, traits, action tendencies, motives, and emotions of other people. Taft concludes that there are individual differences in this ability, the main



attributes being possession of appropriate judgmental norms, judging ability, and motivation. Much more needs to be done by industrial psychologists in evaluating interviewers and their effectiveness in making judgments about applicants before recommending that use of the interview be minimized in the selection procedure. In this connection it must be admitted that to the extent that actual employment interviewing is conducted in the fashion described by Seligson & Brooks (122) selection and training of interviewers is the number one problem.

*Executives and supervisors.*—Executive development has been a popular topic in management literature for several years. To date, little has appeared in print dealing with executive selection. A NICB survey (60) solicited the experience and views of 62 corporate presidents. The state of executive selection is revealed by the estimates that about 20 per cent of executive positions are filled by "pirating," that is, by outside recruitment. When queried as to the method employed in making 200 recent executive appointments in these companies, the presidents reported psychological test scores were used in only 13 per cent of the cases. "Merit" and "natural selection" are more common methods.

Halsey (66) in *Selecting and Developing First-Line Supervisors* devotes three chapters to selection. In the chapter dealing with qualities significant for supervisory success, his criteria for choosing each quality were (a) inclusion in majority of lists of qualities; (b) can be measured with reasonable accuracy by well-standardized tests, by observation of behavior in non-supervisory position, or by special interview techniques. Halsey qualifies his list by pointing out the desirability of each of these qualities although he states that all are not absolutely necessary, since in his view weaknesses can be compensated for by development and use of other qualities. In discussing each of the 16 qualities, Halsey appends a paragraph on method of measurement. For example, on the quality of personal appearance he points out the only method of measurement to be the observer's subjective judgment. On factors such as general intelligence, specific tests are suggested for use.

The place of psychological testing in executive and supervisory selection is hotly debated by management people. One writer (128) describes American management as "riding a new fad—psychological testing." Industry is said to be "test-happy." The most serious indictment is that contained in Whyte's article in *Fortune* (141). Although directed at personality inventories and their questionable validity for predicting success in an executive position, the attack was widely interpreted in management circles as an attack on testing of any kind. If Whyte had been content with general criticisms of personality testing there would have been little objectionable material in his article. Unfortunately, he conducted an "experiment" from which he concluded "if the tests were rigorously applied across the board today, half of the most dynamic men in business would be out walking the streets for a job." Whyte summarized his views on prediction by flatly stating that "who will be best in a critical situation cannot be determined scientifically



before the event." He feels that judgment and intuition judiciously mixed with personal impressions of a man are more certain guides.

The case for psychological appraisal in executive selection is presented by Lewinski (89). He suggests an approach involving five steps: (a) a preliminary interview for the purpose of obtaining and evaluating personal history data and gaining impressions as to qualifications, (b) testing, (c) reference and character check, (d) medical examination, and (e) a final interview for the purpose of determining the suitability of the candidate for an executive level position. The appraisal procedure would be used with candidates for key positions from outside the company, with candidates for promotion to executive level positions, and for key personnel whose performance in a key position is unsatisfactory. Lewinski's discussion of each of the five steps is general and avoids the issues of validity and reliability of the data collected. No mention is made of job descriptions or performance standards. To this reviewer the most serious weakness of present appraisal procedures is the reliance on a clinical, intuitive integration of the data without providing for continuing evaluation.

Guilford (59) obtained answer sheets for the three Guilford personality inventories completed by 405 foremen in an industrial plant together with the proficiency ratings on these men. Guilford hypothesized that use of the "?" represented the personal trait of indecision. If indecision, that is, use of "?", reflected lack-of-self-knowledge, chances of success as a foreman should be poorer. Correlational analysis failed to indicate any relationship between the indecision scores as derived and the criterion.

The Worthington Personal History technique has received considerable attention as a personnel assessment device. Peck & Worthington (115) describe a validation study in which brief individual reports based on the Personal History obtained from 126 office and factory workers were submitted to supervisors for their rating. The authors state that the 126 individual reports contained a total of 1891 statements. An example of one such statement is "can fail on a task he is easily capable of handling or may antagonize his supervisor by openly hostile, rebellious language." Statements were given to 34 different judges who indicated agreement, uncertainty, or disagreement with the statements. It should be noted that statements about any given individual were usually rated by a single judge. The authors report 80 per cent agreement with the statements.

Peck & Thompson (114) studied 17 of the top men in a company organization. The Worthington Personal History, a technique "validated on a variety of levels and types of personnel in clinical practice, and in business and industry" was used. Each statement in each of the 17 reports was rated by two executives who knew the individual well. It is not clear from the authors' description of the rating procedure whether the same two executives rated all 17 reports. Agreement by the judges with 85 per cent of the statements was obtained.

In sharp contrast to the enthusiastic reports which come from members

of the Worthington organization is that of Worbois & Kanous (144). Fifty-three men employed on an inside sales job completed the Personal History. The forms were analyzed by the staff of Worthington Associates, Inc. Although several methods of analyses were employed, the most enlightening involved sorting by six department officials and interviewers of 52 reports into more and less satisfactory prospects for the sales job. This procedure was designed to duplicate the situation which would exist if the consultant prepared reports for use by company staff in the selection procedure. Comparison with a criterion based on supervisory ratings of the men in question indicated that half the men were "misplaced." In the words of the authors, "the Personal History did not help these department officers and interviewers select the better men."

An earlier negative study reported by Clark and Owens has been subjected to criticism by Peck & Stephenson (113) which in turn is rebutted by Owens (112). No opinions were changed in this exchange of views.

The industrial psychologist concerned with executive and supervisory selection is urged to obtain and read a copy of *What Makes an Executive?* (54), a report of a round table on executive potential and performance. There was general agreement among the distinguished participants that executive selection was too often left to "instinct, hunch, or prejudice." However, the consensus of the group was that the contribution of psychological tests was limited at the present time. The discussion of the value of testing as reported suggests that staff psychologists and psychological consultants are failing to convince the top managements of the companies for whom they work.

*Salesmen.*—For at least 40 years psychologists have been working on the problem of selecting salesmen. Although some refinements in selection devices have been made, the basic approach is still that instituted at the Carnegie Institute of Technology Bureau of Salesmanship Research in 1916. A current attempt to improve on present selection devices is Bruce's (26) Sales Comprehension Test. Bruce has taken the 30 most discriminating items from Form A of the test and published them as Form M. Data presented on scores of salesmen versus nonsalesmen, and correlations between grades of students in salesmanship courses and their test scores, suggest that the test may be more a trade test than an aptitude test as originally described. If this is the case, the test would not be as valuable in selecting unexperienced men for training as it would be in selecting from among men claiming sales experience.

Mandell's *A Company Guide to the Selection of Salesmen* (94) reports the findings from an American Management Association questionnaire study undertaken to determine current attacks on the problem of salesman selection and to furnish a guide for companies interested in reviewing present selection methods or developing new ones. The questionnaire (no sample attached) was sent to 578 firms. A total of 180 usable returns were obtained.

Mandell begins by looking at the sales job and the ideal salesman. In-

cluded in the discussion of the sales job is a table listing weaknesses most frequently found in salesmen. Poor planning and organization of time and effort and lack of effort, ambition, aggressiveness, stamina, motivation, etc. are given first mention by over half the companies responding. In Mandell's opinion the list of common weaknesses points to certain basic defects in salesmen. Therefore, if the characteristics of the ideal salesman can be clearly identified, these can serve as criteria for selection. He feels that he has been able to obtain a tentative list of criteria from his questionnaire, from examination of factors used by respondents in rating salesmen, and from review of company selection manuals. Background and experience factors, that is, upper and lower age limits, formal education, and previous sales experience, are disposed of by tabulating the number of companies in each response category. From the replies to the survey and from job analysis information, 13 basic characteristics emerge. These include such characteristics as health and energy, motivation, tempo, mental abilities, loyalty, and independence. Mandell's discussion of the 13 characteristics does not define them in terms which are subject to test. For example, creativeness and imagination are those qualities which distinguish the stable, conservative, routine salesman from the man who has an idea and a "gimmick" a day.

Selection devices reported include the application blank, interview, written tests, and reference inquiries. Use of the weighted application blank is discussed in some detail, although Mandell does not describe the construction of a blank nor does he suggest technical sources on construction. The material on the interview and on written tests contains a good deal of extraneous discussion which could have been eliminated by reference to the research literature on salesman selection. Perhaps the limitations of a study of this kind can be made clear by reference to the fact that only 37 of the participating companies report doing any statistical study of their selection programs.

Bernreuter (21) provides another description of the Klein Institute program. This paper being devoid of quantitative data provides no basis for objective evaluation of the validity of the Klein approach to sales selection.

*Clerical.*—Hay (69) presents findings from tests administered to a small group of clerical employees ( $N=24$ ) which suggest that prediction of success in low-level routine clerical work may be more efficiently accomplished by tests of perceptual speed than by tests of reasoning ability.

Standardization of the General Aptitude Test Battery for the occupation of Tabulating Machine Operator is reported (103). General intelligence, numerical aptitude, spatial aptitude, and clerical ability were found to be related to success as a tabulating machine operator.

*Tests, old and new.*—It is difficult to evaluate a new test battery such as the Job Element Aptitude Classification Tests developed by Flanagan (45). Additional validity data and follow-up studies are needed before the usefulness of the test battery in industrial selection and placement can be determined.

The Strong Vocational Interest Blank widely used in vocational counseling has more recently enjoyed favor as a device to assist in the selection and placement of men in technical, professional, sales, office, and managerial occupations. Badly needed long-term follow-up studies of the predictive power of the SVIB are beginning to appear. Layton (86) in his brief preliminary report of the 1955 University of Minnesota Conference on the SVIB gives just enough information to stimulate reader interest in the to-be-published Conference Report. For example, he summarizes Strong's paper on the 18 year longitudinal study with Strong's conclusion that interest scores do predict future occupational success. On the average for 16 occupational scales, there are 3.5 chances to 1 that a man with an A rating on a given scale would be employed in that specific occupation. On the other hand, if he had a C rating the chances are about 5 to 1 that he would not be employed in the occupation.

As a part of the Harvard Study of Adult Development, 61 men were given the SVIB in 1939 while they were Harvard sophomores. The SVIB was scored for each of these men in 1952. McArthur (98) in his study of the 1953 occupational status of these men found 43 to be in occupations that could be tested directly against SVIB predictions. One half were hit well, that is, these men had entered occupations for which they had an A rating or which were the first, second, or third highest ranking score on the test. One third were clean misses. Seeking an explanation of the findings, McArthur suggests that the SVIB will predict future occupational choices only for those individuals who give weight to their interests in choosing a career. He finds support for this explanation in a comparison of the predictive power of the SVIB in two subcultures. With public school graduates (occupations presumed to be interest determined) hits were made in about three quarters of the cases. With private school graduates (occupations presumed to be determined on some basis other than interests) the numbers of hits were just over half.

Relatively few long range studies of the Kuder Preference Record have appeared despite the wide use of this test in selection batteries. In part this is attributable to its relatively recent introduction and in part to the revisions which have led to the present forms. Because of basic differences in theory and construction it is probable that results from the SVIB cannot be generalized to the Preference Record. Herzberg, Bouton & Steiner (72) retested 273 high school graduates 15 to 49 months after original testing. Although they found stability coefficients to be satisfactory (from .63 for social science scale to .84 for outdoor scale) they do not present any data on the relationship of occupational choice to Preference Record scores.

Jacobs & Traxler (76) as a part of their study for the American Institute of Accountants report the Kuder Preference Record scores of 516 public accountants who describe themselves as satisfied with their work. The profile based on mean scores of these men shows peaks on computational and clerical interests. Outdoor, mechanical, and social service interest areas are low.

Levine & Wallen (88) in their follow-up study of boys counseled at the Cleveland Jewish Vocational Service in 1943, 1944, and 1945 were able in 1952 to obtain questionnaires from 117 of the 215 boys counseled. Present occupations of these young men were coded as belonging to one or more of the nine Kuder interest areas. For each Kuder scale, means of those engaged in an occupation related to that interest area were compared with the mean score on that scale of the balance of the 117 cases. For six of the interest areas mean scores of individuals engaged in a related occupation were significantly higher. The authors conclude that interests measured by the Kuder in adolescence are positively related to later occupation.

The three studies of the Kuder reported here provide interesting additional data on the test, but they add relatively little to our knowledge of its power as a selective device in the industrial setting. Much more needs to be done.

The interest inventory developed by Guilford and his associates (58) offers experimental evidence through factor analysis of factors long suspected by users of the SVIB and the Kuder. As one example, the control-of-others tests as well as the altruism tests have high loadings in the Social Welfare factor. In discussing this finding, the authors describe the factor as involving recognition of needs of others and a desire to help them with strong overtones of wanting to control them. If ways of reducing the length of this test can be found, it may prove to be a valuable addition to present devices for interest measurement.

Ghiselli (52) is of the opinion that forced-choice self descriptions offer a possible solution to the problems encountered when personality inventories are used in personnel selection. To this end he has developed a set of items keyed for supervisory ability which in three groups yield scores that correlate .72, .48, and .26 with ratings. A similar study reported by Denton (39) concludes that a forced-choice personality inventory can be valuable in selection screening.

The Activity Vector Analysis, copyrighted by W. V. Clarke, has achieved a certain degree of popularity as a personality assessment device in some industrial circles. Unfortunately, data are not available for objective evaluation of the reliability and validity of this adjective check list. The only study published in the past year was that of Mosel (106). Inasmuch as the scoring system was not available to him, his analysis was in terms of responses. On a test-retest basis he found considerable individual variation in consistency of response. Ash (9) reports on the Kopas Personnel Tests which purport to measure such things as emotional stability, ambition, and the ability to get along with people. Reliabilities vary and correlations with supervisory ratings are negligible. Another test for which substantial claims have been made, the Kerr-Speroff Empathy Test was distributed by mail to 50 experimental and to 50 clinical psychologists by Siegel (123). Siegel assumed that empathic ability should be greater in clinicians than in experimentalists. The mean Empathy Test scores for the two groups are not significantly different.

While it is clear that the three studies reviewed above are not conclusive they do suggest the need for more careful, independent study of test devices before publication. Thorndike (134) in his remarks about "validation by testimonial" and "validation by use" has stated in blunt language the shortcomings of much current research on selection and appraisal. Until industrial psychologists are able to administer tests, inventories, and other selection devices, lock up the results for a period of time and then compare predictions with performance appraisals, it will be difficult to make unequivocal statements as to the validity of many selection and appraisal procedures now used.

### TRAINING

Management or executive development currently is one of the controversial issues in management circles. While corporate executives agree on the need to stimulate the growth and development of junior managers and supervisory personnel, there are serious differences of opinion with respect to the most effective means for accomplishing these objectives. Stolz (129) in his survey of the present status of executive development programs questions the value of many formalized plans on the grounds that mechanics and procedures have become an end in themselves. A review of reports describing company plans tends to support this view.

The management development plans of 10 companies have been described in detail by Simpson (124). Each company differs from the others in terms of formal structure of their plans, the use of assessment devices, and the extent of participation by the staff in the details of the plan. The one thing in common to all companies described in this report is the absence of formal evaluation of the plans. "Successful growth of the company in recent years," "executive requirements over a long period of expansion have been met," or, "continued successful expansion" are typical management answers to questions as to success or failure of a plan. As is always the case when a personnel program is in "style" the management literature is full of articles describing programs, techniques, and approaches.

Buchanan (27) has written a very thoughtful paper dealing with problems of evaluating the outcomes of development programs. After a brief review of present approaches to evaluation he proposes a method of evaluating the training process based on judgments or ratings of eight specific factors: "clarity of program goals;" "adequacy of methods used in determining training goals;" "congruence of expected and obtained happenings in sessions;" "repetitions of errors by training staff;" "bridging between training and day-to-day performance."

Experimental studies reporting evaluative data on the outcomes of training programs are infrequently encountered in the literature. Mosel & Tscarnis (107) report a study in which How Supervise? was used as the evaluative instrument. After a 40-hour supervisory training course extending over six weeks, scores of 83 supervisors showed significantly more gain than



did a matched control group not exposed to the training. The authors recognize that attitude improvement does not guarantee corresponding improvement in on-the-job-behavior. Whether a small gain in mean score on How Supervise? reflects attitude change in the group trained is debatable.

Di Vesta (40) in a more elaborate study compared outcomes of a 20-hour human relations training program for military medical administrative supervisors in terms of relative effectiveness of teaching methods and in terms of increase in achievement level. The 118 students were divided into a control group ( $N=24$ ) which received technical instruction but not the human relations training and an experimental group. The experimental group was further subdivided into two groups one of which received instruction by a student-centered discussion method while the other group received instruction by the instructor-centered method. All groups were given the same pretest and posttest battery. Both experimental groups showed significant change in achievement. Use of the discussion method appeared to have a slight advantage over the instructor-centered method although, as the author cautions, this is a tendency, not a clear-cut difference.

An interesting subjective evaluation of a company induction and training program is reported by Bloomer (23). He took a job in an aircraft plant and completed the program just as any new employee. If handled properly this kind of check on company programs might be helpful as one kind of evaluative device. Probably all newly employed personnel staff members should be given a similar introduction to a company.

Little research has been reported on persistence of change resulting from training. McGehee & Livingstone (100) in an extension of an earlier study on waste reduction in a textile mill have found that the effects of their training program persisted over a period of two years. They attribute the success of the plan to: (a) presenting frankly, fully, and sincerely the reasons for any change to all who will be affected by it; (b) enlisting participation, at their level of competence, of individuals involved in the plan by assigning them specific tasks to perform; (c) keeping the individuals involved informed concerning the outcomes of the project.

Perhaps the best way to close this section on training is by reference to Edgerton's (41) paper on needs in training research. After discussing schools of training practices, training devices, and instructor performance, he turns to the need for research in individual differences in the persons being trained. Edgerton points out that learning rates and amount already learned will differ between individuals to be trained. Greater efficiency of the training program may result if faster and slower groups can be identified. He suggests an interesting hypothesis for test: men who differ in their patterns of cognitive abilities and skills will learn more effectively when trained with correspondingly different methods.

#### JOB ANALYSIS, DESCRIPTION, AND EVALUATION

Otis & Leukart (111) have published a revised edition of their text on job evaluation. This continues to be a standard work on job evaluation.



McCormick & North (99) describe an experimental job evaluation system developed for application to enlisted naval jobs. Although 13 factors were used, five of the factors accounted for the major portion of the variance in criterion scale values (rankings by 29 judges on basis of over-all difficulty and responsibility). Two factors, work knowledges required and guidance or supervision received, probably would adequately predict the criterion. This finding is entirely consistent with earlier studies in industry. By way of contrast, however, are the findings of McQuitty, Wrigley & Gaier (101) who report on a study of Air Force aircraft and engine mechanics. Their data seem to minimize technical knowledge as a factor in job success and to emphasize factors of interest and motivation.

The guide chart-profile method of job evaluation developed by Hay and his associates (68) is designed primarily for use with jobs at management and executive levels. The system rests on adequate evaluation of jobs in terms of three factors: know-how, problem-solving, and accountability.

The personnel literature regularly reports surveys and descriptions of company practice in administering evaluation and compensation plans. As long as payroll charges are a major factor in production costs, managements will continue to seek for new control schemes. Until a great deal more is known about motivation in the work situation, present plans serve primarily to alleviate more obvious inequities.

A new classification of occupations has been proposed by Roe (117). She has taken two factors of responsibility and skill and primary focus of activity and divided each into eight levels or groups. The responsibility and skill axis of the resulting  $8 \times 8$  table has major subdivisions of innovation, transmission, application, and support or maintenance. Primary focus of activity is subdivided into physical activities, personal interactions, and knowledge of the world and the works of man. Roe can successfully classify most occupations, although she notes that the occupation of psychologist does not fit conveniently into any single cell so it is placed according to psychological specialty.

The literature on the critical incident technique has been reviewed by Flanagan (46). His section describing the present form of the technique gives extensive procedural detail concerning general aims, plans and specifications, collecting and analyzing the data, and interpreting and reporting.

Mandell & Duckworth (95) claim that most information about the supervisor's job is based on subjective sources unsystematically presented. In an effort to obtain factual data they observed 82 first level blue-collar and clerical supervisors for a total of 108 days. In addition, they obtained narrative statements from 770 blue-collar supervisors. About one-third of supervisory activity and supervisory time was classified as "reviewing work and instructing and correcting workers." Scheduling work was the second most frequent and time consuming activity. Personnel administration and human relations activities accounted for only 7 per cent of time and activities!

The findings of this study emphasize the technical as opposed to the human relations aspects of the supervisory job. As the authors point out,

however, each technical duty has a personnel component. Assigning work or inspecting work for accuracy may call for technical knowledge but to whom the job should be assigned, how it is assigned, and the tact shown in reviewing work all require skill and understanding in dealing with people.

In two papers Davis & Canter (35) and Davis, Canter & Hoffman (36) suggest that productivity may be improved through more effective job design. By job design, the authors mean the organization of a job to satisfy the technical-organizational requirements of the work to be accomplished and the human requirements of the person performing the work. They propose a job-centered approach which takes into account the interaction between organization, worker, and job. Findings from their survey of current industrial practices point to job design as an area where intensive research and study may lead to substantial gains in worker effectiveness.

#### EQUIPMENT DESIGN AND ACCIDENTS

*Equipment design.*—Most studies of equipment design reported in the literature have been undertaken with military applications in mind. One notable exception is the study carried out at the Bell Telephone Laboratories which was reported by Scales & Chapanis (119). They state that despite frequent recommendations for inclined visual displays and control panels there is little evidence relating this design practice to operator efficiency. In the present study they investigated the effect on performance of tilting the toll-operator's keyset. The keyset used by a long distance operator has 10 buttons (numbers and letters) arranged in two vertical rows of five buttons each. In the experimental situation the keyset was inclined at eight angles between 0 and 40 degrees relative to the working surface. Sixteen subjects with no previous experience on this keyset were used. Performance measured by keying accuracy and keying time were found to be independent of the inclination of the keyset.

Browne (25) in a study of two types of horizon indicator compared speed and accuracy of control movements in an instrument flying trainer. One instrument shows the field or miniature plane stationary, the horizon moving. The second instrument has the plane move against a fixed horizon, the ground. Speed and accuracy of response was greater with the second instrument. Browne's discussion of problems encountered in research of this kind is worthy of the attention of anyone concerned with the relative superiority of two methods or devices.

Problems of the operator who must search visual displays for necessary information were examined by Eriksen (42). The time required to locate a constant number of signals in a square display increased when the number of irrelevant signals increased and when the number of partitions increased.

Military applications, particularly in the design of training devices, appear to be important considerations in the studies of Muckler & Matheny (108), Lincoln (90), Jenkins & Karr (77), and Garvey & Knowles (50). All of these studies appear to have been carefully planned and carried out. Where

security considerations permit, understanding and possible use of these findings might be facilitated if military or civilian tasks simulated in the laboratory experiment were described in more detail.

*Safety.*—Psychological research on accidents has been hampered by statistical and methodological problems, e.g., interpretation of deviation from a Poisson distribution, personal versus situational factors, the significance of accident histories, and the estimation of risk or exposure to hazard. Teel & DuBois (133) in their paper propose four refinements which in their opinion will make future studies more useful: (a) more sensitive accident criterion measure, (b) better differentiation between personal and situational accidents, (c) systematic collection of information on exposure to hazard, (d) correlation of individuals' scores on theoretically related predictor values and their record of accidents in which measured traits are considered important.

Mintz (104) examined the accident records of 172 taxi drivers. The records covered a period of one year. Sixty drivers had no accidents and 112 drivers had from 1 to 25 accidents. With respect to time intervals between accidents his data suggest that individual proneness to accidents is not materially changed by the fact of having an accident.

Van Zelst (136) in a study of age, experience, and accident rates found a sharp decline in the accident rate during the first three to five month period of employment followed by a leveling off through the work period. Lower accident rates were characteristic of older men.

#### CONSUMER RESEARCH AND ADVERTISING

Littman & Manning (91) criticize recent studies of brand discrimination in which identification of the brand was used as a criterion of discriminability. In their study the use of a recognition judgment and an affective (like-dislike) judgment were compared. A total of 246 regular cigarette smokers served as subjects. One half made a recognition judgment and the remaining half made a like-dislike judgment. Each subject partially smoked one of the three common brands with the brand name obscured. Both types of judgment were made with better than chance accuracy although the like-dislike technique appeared to be more sensitive. In terms of absolute level of accuracy "my brand: yes-no" responses ranged from 30 to 40 per cent correct. Like-dislike judgments for own brand ranged from 50 to 70 per cent correct. Better than chance perhaps but hardly consistent with advertising claims.

The "pros" and "cons" of consumer motivation research (CMR) are discussed by Blake (22). Although data are closely guarded by research organizations and their clients, the author is of the opinion that planning of advertising and sales campaigns is being influenced by CMR studies. A popular version of current motivation studies is found in the *Business Week* series (5).

Clements, Bayton & Bell (31) and Bayton & Thomas (18) report studies of consumer reaction to several canned orange juices which differed in sweet-

ness or in body or consistency. Some subjects liked it sweet and some liked it sour.

Tiffin & Winick (135) compared the results from group tachistoscopic presentation of magazine advertisements with data of individual presentations using the Purdue Eye Camera. They conclude that results from the two methods are sufficiently similar to warrant use of the group method in measuring attention power of advertisements.

#### HUMAN RELATIONS

In the human relations area Argyris' *The Present State of Research in Human Relations in Industry* (7) is probably the most significant publication during the year. He examines human relations research being carried on in 20 university centers and by seven individual researchers using a presentation organized around statements of principles, concepts, generalizations, and research methods of each research center and individual. Argyris divides research being conducted into (a) additions to basic knowledge and (b) use of social science in action. Among the 27 units studied he finds over half conducting basic research on organization and organizational theory, development of valid and reliable research methods, individual adaptation, and leadership. Twenty of the units are studying administrative principles based on social science results. Leader training is a subject of applied research in half of the groups.

In Argyris' opinion most of the basic research is being directed toward answering three basic questions: (a) What is the nature of organization? (b) Why do participants in an organization behave the way they do? (c) How can one "manage" or "integrate" the individual participant's behavior so that the organization may survive and effectively achieve its goals? Of particular interest to the industrial psychologist is Argyris' discussion and summary of the work being done on managing and integrating participants' behavior. He suggests that research efforts have gone in two directions in seeking answers to this question. In one case it is hypothesized that behavior can be managed by influencing it in the desired direction. This approach has led into the study of leadership. The second approach speaks of constructing an organization in which the participants will automatically manage and integrate their own behavior because in so doing they will gain personal satisfaction.

Three types of definitions of leadership are exemplified in the work of the research centers. One uses the concept of influence; the second, the concept of dependence; and the third, the concept of need fulfillment. Although Argyris feels that the three are complementary he prefers the third definition since it suggests that the informal leadership in an organization will go to that person who is perceived by the group members as being best able to fulfill their needs.

Some years ago when scientists and business men were first looking at organization theory, organization structure was considered most important.

Later, with the development of a body of human relations theory and research primary concern was with individual aspects. Motivation was given equal or greater importance than organization. Argyris is of the opinion that there is a shift of emphasis to organization again. He believes that much behavior now explained in complex terms of motivation could be more easily explained and understood if viewed in terms of individual adaptation to and learning of organizational demands.

*Organization.*—An entire new area of personnel management, organization planning, is getting increased attention. As described by Allen (1) organization planning is concerned with (a) logical grouping of company activities, (b) delineation of authority and responsibility, (c) establishment of relationships for the purpose of enabling people to work together most effectively in accomplishing the organizational objectives. Among the ways in which the industrial psychologist can contribute to organization studies are by identifying activities which can be grouped so as to give the people performing them the greatest satisfaction consistent with efficiency, working with job incumbents so that they may fully understand their duties, and study and evaluation of committee performance. Gaiennie (49) in discussing extension of position and personnel evaluation has proposed several suggestive questions for experimental investigation: (a) Is it better to place individuals in positions which just equal, exceed, or are less than their abilities? (b) What are the effects on efficiency and morale when less capable people are placed over more capable people? (c) Is it possible to have an efficient organization without positive position and personnel gradients? (d) Given a particular set of conditions, are there particular gradients which return optimal results?

Four studies in a series designed to discover variables related to organizational effectiveness are reported by Comrey *et al.* (32, 33, 142, 143). The general plan of this research has been to administer questionnaires to individuals in work units and to analyze the data against criterion measures of work unit effectiveness in order to determine whether there are characteristic response differences between "more effective" work units and "less effective" work units. Of particular importance to organizational theory is the finding (33) that "management dimensions" such as planning, safety enforcement, and job competence are more significant variables than "human relations dimensions" such as pride in work group or communication. These findings apparently are very discouraging to the authors since they suggest that perhaps psychological research may be emphasizing secondary rather than primary determinants of organizational effectiveness, thus creating the impression that running an organization is principally a matter of good interpersonal relations and only secondarily dependent upon technical knowledge and skills.

One aspect of organization which warrants intensive study is that labeled "company character," or "corporate environment." Buchele (28) reviews several studies reporting outcomes of supervisory training programs, job evaluation programs, and employee selection programs in which success or

failure of the program appeared to be related to the characteristics of the particular organization in which the study was done. He suggests some items for use in a check list that are worth study as a device for describing companies.

*Leadership.*—A large number of studies have been reported on leadership. Many have been disappointing. Cattell & Stice (29) believe that failure stems from the personality measures used, the leadership definitions employed, and the tendency to ignore suggestive relationships found. In their study, four leadership categories were examined: problem-solving, salient, sociometric or popular, and elected. Eighty groups of 10 men each met for three 3 hr. sessions to perform a wide range of tasks. Personality was measured by the 16 Personality Factor Questionnaire. Scores of leaders and non-leaders were contrasted. The authors derive a multiple regression equation for the elected leader pattern which accounts for 82 per cent of the criterion variance and yields a  $R$  of .91.

Bass (15, 16) in reviewing the use of the leaderless group discussion as a leadership evaluation instrument suggests that the value of the leaderless group discussion may be attributable to the requirement that the leader adequately communicate verbally with those he leads. The industrial psychologist seeking to use the technique must consider that, for maximum validity, problems equally ambiguous to all participants and requiring initiation of structure for their solution should be used. In other words, the closer the situation is to the real life setting, the higher the validity.

French (48) in his discussion of research efforts directed toward predicting the "adaptability to the Service" trait in U.S. Coast Guard Academy Cadets concluded that this trait is a very complex quality not well predicted by tests.

Two studies analyzing leadership behavior of aircraft commanders have been reported by Halpin (64, 65). Of particular interest are his findings relating commanders' ideology of how they should behave as leaders and their crews' perception of their leader behavior on the two dimensions: initiating structure and consideration. Initiating structure includes the behavior involved in defining organizational relations, channels of communication, and ways of getting the job done. Consideration is the human relations dimension. A total of 132 aircraft commanders answered the Leader Behavior Description Questionnaire indicating how they believed they should behave as leaders. Their crews (1103 men) described the commanders' behavior using the same questionnaire device. For both dimensions negligible correlations were obtained between the two sets of ratings. On the basis of these findings Halpin cautions those engaged in leadership training against accepting trainees' statements of how they should behave as evidence of parallel changes in behavior. It is encouraging to see this point well made. Some carefully planned and well-intentioned "human relations" training programs have failed because classroom acceptance was interpreted as evidence of behavior changes.

Jennings (78) reports a novel experimental study undertaken in an in-



dustrial setting. Forty supervisors were divided into two comparable groups, A and B. Group A was given a 16 session human relations training program using the conference method. Group B was given their training using a forced leadership method. At each session forced leadership was obtained by assigning members of Group B to small discussion groups on the basis of leadership performance in the previous meeting. By the seventh session only two supervisors remained who had not assumed the leadership role. The cycle was then repeated. Jennings does not describe details of his evaluation procedure but he states that an evaluation made six months after the program was completed showed 14 Group B supervisors in the upper half of the ranking and only 6 Group A supervisors. Since the evaluators are said to have been unaware of the procedure or details of the training program, it would appear that relative change was greater for those trained using the forced leadership method.

Harris & Fleishman (67) compared leadership behavior patterns over a period of time for foremen who had received human relations training with those who had not received this training. The Supervisory Behavior Description Questionnaire was completed by at least three employees working under each of the 98 foremen in the study before the training program and again almost a year later. The Leadership Opinion Questionnaire was completed by the supervisor himself. In terms of mean scores before and after training the effects of training do not appear to be significant. The authors observe that their findings are not completely negative since they have some evidence of differential effects of the training on individuals.

*Attitudes and morale.*—To a considerable extent corporate personnel policies and practices affect employee attitudes and morale. Baker & France (12) report a comprehensive study of centralization and decentralization with respect to industrial relations activities. They point out the great appeal of ready adjustment of industrial relations policies and practices to local conditions. But they warn that the concern which seeks to prosper must earn the respect and loyalty of all groups in its employ by policies which prevail throughout its operations. In any large corporation this presents a dilemma which has not yet been resolved. On the one hand communication and participation, both desirable, are encouraged in a decentralized organization. On the other hand, fair personnel policies and opportunities for advancement may be more likely in a centralized organization. Baker & France propose no general solution.

Studies by Cleland (30) and by France (47) extend the Princeton studies. Cleland in his investigation of the effect of plant size concludes that small plants (under 500 employees) are more likely to have a favorable plant atmosphere allowing for intimate personal contact. Small plants are also more likely to have a cohesive work force. France discusses the centralization issue faced by national unions which is essentially that of the corporation.

Haire (63) in an investigation of the perception of personality as influenced by the functional role in which perceived, used two pictures and four



descriptions. In half the cases the individual portrayed was described as a "manager" and in half the cases as a "union official." Pictures and descriptions were shown to personnel or industrial relations men and to local labor leaders after which an adjective check list was administered. Although Haire cautions against overgeneralization from his data, the findings do suggest the kind of distortion that can occur, for example, (a) the general impression of a person is radically different when seen as a management member than when seen as a labor representative; (b) management and labor each sees the other as less dependable than himself; (c) management and labor each sees the other as deficient in thinking, in emotional characteristics, and in interpersonal relations in comparison with himself. Haire sees in this distortion a serious barrier to communication and the resolution of differences between management and labor representatives.

Mann & Dent (96) report on another phase of the long-term research project investigating change in employee attitudes (Detroit Edison Company). In this study, attitudes and opinions of Accounting Department employees toward their supervisors were compared with evaluations of the supervisors by department heads. In the case of very effective supervisors or ineffective supervisors there is considerable agreement between employee attitudes and department head evaluations. For example, a highly rated supervisor is more likely to be viewed by his employee as a "leader of men," "likeable," and "reasonable in what he expects." This report is worth study both in terms of content and in terms of form of presentation. Industrial psychologists still have much to learn about presenting material to a business audience.

In Nagle's (109) study of attitudes and productivity he found a high relationship between attitude toward the supervisor and rated productivity of the department. More favorably regarded supervisors were also more sensitive to their employees' attitudes.

Three studies of the SRA Employee Inventory are reported. Baehr (11) carried out two factor analysis studies. The survey data for one analysis were obtained from junior executives, private secretaries, and stenographers who enjoyed a relatively high status in the headquarters office of a merchandising organization. The second analysis was based on survey data obtained from relatively low status clerical and factory employees in a branch plant of a manufacturing organization. Baehr found four factors common to both groups which are identified as: immediate supervision, job satisfaction, integration in the organization, and friendliness and co-operation of fellow employees. In addition to the common factors there were three factors unique to Group I and four factors unique to Group II.

In a somewhat more elaborate investigation, Ash (10) administered the SRA Employee Inventory, the Brayfield-Rothe Job Satisfaction Scale, the Wonderlic Personnel Test, the Thurstone Temperament Schedule, and a personal data sheet to 184 employees of a steel container fabricating plant. Five of the seven factors extracted are identified as: personality integration, job rewards, management effectiveness, immediate supervision, and job satisfaction.

Wherry (140) has taken the data of the Baehr and Ash studies and subjected them to reanalysis since he feels strongly that the analyses overlook a "general bias" or attitude factor. His rotation identifies this general factor plus four group factors: working conditions and environment, financial reward, supervision, and effective management and administration. These factors can be identified in all three sets of data. This reviewer makes no claim to expertness as a "factor analyst" so the reader can continue oblique or orthogonal solutions as he prefers. Wherry's analysis appears more sound psychologically.

Anikeeff (2, 3, 4) in three reports dealing with the results of one study of attitudes toward issues such as labor unions, government control, free enterprise, and personnel policy contrasted questionnaire responses obtained from business administrators, salaried employees, and students of business administration. Differences between these groups were largely confined to items where government control was the issue. Students, salaried employees, and business administrators favored government control in that order.

Bass (14) administered a check list of 138 statements about work groups to 250 college students who were able to describe two pleasant or two unpleasant work groups to which they had once belonged. Each rater described an efficient and an inefficient work group. Although Bass clearly recognizes the limitations of the data of this study, his findings suggest several hypotheses for further research. If adequacy of facilities and abilities are held constant, and morale is lowered in a group, will productivity decline most in groups where membership continues to be pleasant?

Kirchner & Dunnette (82) have found that management attitudes toward older workers are generally more unfavorable than toward any other group of employees. Attitudes toward older workers on the part of local unions have also been studied by the same authors (83). Their findings suggest that at the local level there has been little or no thought given to utilization of older workers. Bernberg (20) in a study of age and morale found older workers to have higher morale scores. Length of service did not appear to have a significant effect on morale scores. Noetzel (110) in his paper discusses some of the problems of retirement. Preretirement programs have become more popular in recent years although little is known of their value.

Attitudes toward the company and toward the union were studied in three companies by Dean (37, 38). The smallest of the three companies has enjoyed a period of peaceful co-existence. Interest and participation in union affairs are low. The largest company has had a history of intense conflict with two long strikes. The second strike (in 1947) was lost by the union but, according to Dean, at the time of the survey much of the poststrike bitterness had disappeared. In the third plant, according to the author, union-management friction prevails. Dean's data suggest that positive attitudes toward management may be related to positive attitudes toward the union, regardless of the degree of conflict in the union-management relationship. She also finds evidence to support the view that negative attitudes toward management lead to regular union activity only where there is open

hostility between union and management. Where the union-management relationship is relatively good the feeling of personal identification and responsibility promotes active participation.

The findings with respect to the positive correlation between attitudes toward the company and toward the union confirm findings from earlier studies reported by Stagner (126), Purcell (116), and Kerr (81). Rosen (118) in his critique of these studies suggests that the researchers are getting at measures of the workers' loyalty in two different roles, as union members and as company employees, or in terms of two different sets of expectations concerning a single role, as unionized employees. He feels that the findings are not predictive of behavior when a choice between roles or expectations must be made. Rosen proposes that the question be studied in the context of contradictory demands on the worker. Which allegiance will then stand?

For the purposes of his study Gordon (57) defines high morale as the feeling of well-being that an individual experiences when his needs are being filled to his satisfaction. A confidential questionnaire was administered to groups of clerical workers at a government installation in order to obtain measures of the degree to which employee needs were being filled. Three factors, overall satisfaction with need fulfillment, need for social recognition of status, and need for self-respect were tentatively identified as representing the original seven need categories. The relationship of measures of morale to productivity is not clear.

Moore & Renck (105) report that professional employees, including engineers and natural scientists, tend to be chronically frustrated and dissatisfied. The authors attribute the low morale state to a fundamental conflict between the expectations and values of the professional employee and his opportunity for realizing his ambitions and interests in the industrial setting.

Bluestone (24) has summarized eight major studies of (a) why workers quit jobs and (b) take new jobs, and (c) what factors tend to keep workers from changing jobs. Although lack of methodological uniformity makes findings tentative, the data suggest that personal relationships and family problems as well as wages, physical conditions of employment, and long range possibilities are important determinants. Seniority provisions and dangers of unemployment or of getting a poorer job are reported to be major deterrents to job changing.

In two morale surveys reported by Herzberg (71) respondents were required to write comments on factors for which they had the strongest feeling. The author reports that this technique produced meaningful comments. Unfavorable comments were more specific than favorable comments.

Johnson (79) has constructed another job satisfaction questionnaire consisting of 99 items covering physical and mental exertion; relations with associates; relations with employer; security, advancement, and finances; interest in, liking for, and emotional involvement in the job; job informa-

tion and status; physical surroundings and work conditions; future, goals, and progress toward goals; and evaluation in retrospect. Reliability seems to be satisfactory although validity is inferred from the nature of the construction of the instrument, ratings of individual items by graduate student judges, ratings of work characteristics for importance to job satisfaction, and correlations between self-estimates of satisfaction and scores on the scale.

Kunin (84) reports on the "faces" used by Laseau and Evans of the General Motors Employee Research Division. Two sets of 11 faces (one characterized, one circular) ranging from happy to unhappy were studied. Kunin concludes from his data that characterized faces have greater potential value as measuring devices.

Hearnshaw (70) in an interesting paper expresses his conviction that studies of attitudes toward work now carried out by industrial psychologists are too narrow, being confined to studies of attitudes toward specific features of work, toward inter-factory comparisons, or toward changing attitudes. He feels that much more must be done in studying attitudes in terms of social context and the changes in attitudes accompanying changes in society over the years.

What makes people want to work? How can management motivate employees to put forth greater effort? What is a fair day's work? Discussion of these questions has been going on for many years yet no satisfactory answers have been suggested. Ginzberg (53) in reviewing some of the problems and proposed solutions lists three general aspects which he considers important: (a) management's motivational objective is the establishment of conditions conducive to production of the largest amount of good work, on a sustained basis, at the lowest possible cost; (b) management goals and values are not necessarily those of employees; (c) the work force is not a homogeneous unit. Using examples in the areas of selection, assignment, pay, and promotion the author discusses management attempts to motivate individuals. The lack of success in many of these attempts is attributed to failure to consider individual values and goals and their relation to job attitudes. Ginzberg closes his paper on a rather pessimistic note by suggesting that industry might accomplish more through identifying and motivating the minority who seek to realize themselves through work than by trying to influence the majority who are concerned with peace and security.

There may be a certain practical wisdom in doing as Ginzberg suggests if the attitude toward the use in industry of group dynamics techniques expressed by Gomberg (56) is common throughout union circles. Gomberg considers many present efforts as manipulative, that is, as producing benefits for management without corresponding benefits for the employee.

Studies of the effect of company plans as to automation, e.g., installation of computers, continuous production, or introduction of feedback control devices, on employee attitudes and morale have not yet appeared in the literature. Baldwin & Shultz (13) in their discussion of problems likely to be

encountered may be overoptimistic in their estimate of reactions of unions and employees. Specific studies of communication of company plans on automation would be helpful at this time of change.

#### THE STATUS OF PERSONNEL RESEARCH IN INDUSTRY

Fitzpatrick & Hahn (44) reported on a survey of personnel research in industry made in 1952 for Air Force consumption. The survey included six civil government agencies and 54 industrial concerns. Survey findings were organized into six areas: (a) selection and classification, (b) training, (c) performance evaluation, (d) job evaluation, (e) safety, (f) morale. In each of the areas the authors found a lack of evaluative studies. Many of the companies surveyed were planning research or were engaged in research, but the authors concluded that only isolated studies had been produced which could be applied by the military. In a research note (6), apparently by the same authors, it is stated that there seems to be an increasing awareness in industry of the value of developmental personnel work and of systematic studies designed to measure the effectiveness of various techniques and procedures.

Current research in industrial and labor relations being conducted in university centers is summarized in a bulletin published by the New York State School of Industrial and Labor Relations (8). A heavy concentration in the areas of collective bargaining and various aspects of wage theory is observed.

With the growth of basic social science research programs, particularly in university centers, there is a need to take research out of the laboratory into industry. Massarik & Brown (97) have described some of the problems encountered in gaining access to an organization. On the whole, they have covered stated objections and unexpressed resistances commonly encountered. Three problems not mentioned are: (a) maintaining constant liaison with company management, (b) lag in reporting findings, and (c) research personnel, themselves.

Members of a research group planning to do basic social science research in an industrial organization should be prepared for something less than full support at various levels in the organization. They must also be aware of the dynamic nature of industrial organizations. Normal turnover in the management and supervisory groups can bring into key positions individuals who are ignorant of or hostile toward the research program. Internal political alignments may change. Economic conditions may result in shifts in company plans leading to changes in attitudes toward the social science research program. If the research group keeps "in touch" with the key members of an organization changes affecting the program can be anticipated or dealt with before serious damage is done to the program.

If the primary objective of a business enterprise is the production of goods or services at a profit it follows that providing a testing ground for social science theory is a secondary matter. Even an alert, progressive management will be more involved with the conduct of the business than with the work of the research team. If interest in the work of the research group is to be main-

tained a plan for continuous feedback of information to management (and to union representatives when applicable) is an essential part of the research design.

Very little has been done with respect to the research man and his effect on the organization which he is studying. What are the effects of age, educational and cultural background, and personal characteristics? Can knowledge of the climate of the company and habitual approaches to accomplishing organizational objectives come only through long term observation and "living in" the plant or office?

For the industrial psychologist there are two additional problems which need attention if research efforts are to be productive and contribute to the understanding of people at work: (a) more efficient communication channels must be found for transmission of research findings, (b) the respective roles of academic research groups and of research men in industry must be clarified.

It is apparent to anyone familiar with the literature that a substantial amount of the work being done in industry is not finding its way into the traditional publication outlets. About 40 per cent of the members of Division 14 of the American Psychological Association are employed full-time by a business or industrial concern. Yet a check of the institutional affiliation of authors writing in recent issues of the *Journal of Applied Psychology* indicates that less than 10 per cent of the articles are by authors with a full-time job in industry. This might be interpreted in some circles as a sign that no worth-while work is being done in industry. The experience of this reviewer, however, is to the contrary. Some excellent work is being done by psychologists in industry. Unfortunately, the results are being communicated through personal contact or in small meetings of industrial research men. The informal nature of these meetings, on the one hand, makes possible free discussion of approaches and techniques used, reasons for success or failure, and the significance of findings for industry. On the other hand, this method of disseminating information tends to restrict the information to a rather small group. The Validity Information Exchange which appears in *Personnel Psychology* and the section on Applied Psychology in Action of the *Journal of Applied Psychology* represent steps in the right direction.

In addition to the need for a more efficient means for interchange of ideas and research findings between industry and academic people there is a need for better definition of their respective roles in research. The psychologist in industry may function at any one of many levels according to his own interests, skills, experience, status, and the organizational environment in which he works. In any case, his research activities probably are limited to short-term or "fire-fighting" projects. Of course, insofar as is possible, he will encourage basic research and will interpret research findings to his company management. In the opinion of this reviewer, the industrial psychologist working in this way is performing a useful function.

Allocation of long-term basic social science research to university centers



and to research foundations has many advantages. It makes possible the co-operative efforts of specialists from many areas. As Fisher (43) has observed, "No single discipline has any special claim on the field." And not to be overlooked is the possibility that many university research personnel will be freed from the burden of dealing with matters of limited scope and permitted to engage in work of fundamental significance.

## LITERATURE CITED

1. Allen, L. A., "Organization Planning," *Management Record*, **16**, 370-73, 402-4 (1954)
2. Anikeeff, A. M., "Attitudes on Social Issues of Business Administrators and Students in a School of Business Administration," *J. Appl. Psychol.*, **38**, 407-8 (1954)
3. Anikeeff, A. M., "Attitudinal Comparison of Business Employees and Students in the School of Business Administration," *J. Appl. Psychol.*, **39**, 65-66 (1955)
4. Anikeeff, A. M., "Study of Attitudinal Divergence Between Business Administrators and Salaried Employees," *J. Personnel Administration and Industrial Relations*, **1**, 198-201 (1954)
5. Anonymous, "Motivations," *Business Week*, 19 pp. (Reprinted from issues of August 14, 1954, August 21, 1954, August 28, 1954)
6. Anonymous, "Personnel Research in Government and Industry," *Am. Inst. Research, Research Note No. 11* (December, 1954)
7. Argyris, C., *The Present State of Research in Human Relations in Industry* (Yale Labor and Management Center, New Haven, Conn., 244 pp., 1954)
8. Aronson, R. L., Ed., *Industrial and Labor Relations Research in Universities* (New York State School of Industrial and Labor Relations, Ithaca, New York, 48 pp., 1954)
9. Ash, P., "Reliability and Validity of the Kopas Personnel Test Battery," *J. Appl. Psychol.*, **38**, 155-56 (1954)
10. Ash, P., "The SRA Employee Inventory—A Statistical Analysis," *Personnel Psychol.*, **7**, 337-64 (1954)
11. Baehr, M. E., "A Factorial Study of the SRA Employee Inventory," *Personnel Psychol.*, **7**, 319-36 (1954)
12. Baker, H., and France, R. R., *Centralization and Decentralization in Industrial Relations* (Princeton University Press, Princeton, N. J., 218 pp., 1954)
13. Baldwin, G. B., and Shultz, G. P., "Automation: A New Dimension to Old Problems," *Monthly Labor Rev.*, **78**, 165-69 (1955)
14. Bass, B. M., "Feelings of Pleasantness and Work Group Efficiency," *Personnel Psychol.*, **7**, 81-92 (1954)
15. Bass, B. M., "The Leaderless Group Discussion," *Psychol. Bull.*, **51**, 465-92 (1954)
16. Bass, B. M., "The Leaderless Group Discussion as a Leadership Evaluation Instrument," *Personnel Psychol.*, **7**, 470-76 (1954)
17. Bayroff, A. G., Haggerty, H. R., and Rundquist, E. A., "Validity of Ratings as Related to Rating Techniques and Conditions," *Personnel Psychol.*, **7**, 93-114 (1954)
18. Bayton, J. A., and Thomas, C. M., "Comparative and Single Stimulus Methods in Determining Taste Preferences," *J. Appl. Psychol.*, **38**, 443-45 (1954)



19. Bellows, R. M., *Psychology of Personnel in Business and Industry*, 2nd ed. (Prentice-Hall, Inc., New York, N. Y., 467 pp., 1954)
20. Bernberg, R. E., "Socio-Psychological Factors in Industrial Morale. III. Relation of Age to Morale," *Personnel Psychol.*, **7**, 395-400 (1954)
21. Bernreuter, R. G., *Methods and Instruments in Sales Aptitude Testing* (Klein Institute for Aptitude Testing, New York, N. Y., News Letter No. 14, 12 pp., 1955)
22. Blake, J. K., "Consumer Motivation Research," *Dun's Review and Modern Industry*, 30-33, 46 (July, 1954)
23. Bloomer, R. H., "Psychologist on the Job Appraises a Training Program," *Personnel J.*, **33**, 6-9 (1954)
24. Bluestone, A., "Major Studies of Workers' Reasons for Job Choice," *Monthly Labor Review*, **78**, 301-6 (1955)
25. Browne, R. C., "Figure and Ground in a Two Dimensional Display," *J. Appl. Psychol.*, **38**, 462-67 (1954)
26. Bruce, M. M., "A Sales Comprehension Test," *J. Appl. Psychol.*, **38**, 302-4 (1954)
27. Buchanan, P. C., "A System for Evaluating Supervisory Development Programs," *Personnel*, **31**, 335-47 (1955)
28. Buchele, R. B., "Company Character and the Effectiveness of Personnel Management," *Personnel*, **31**, 289-302 (1955)
29. Cattell, R. B., and Stice, G. F., "Four Formulae for Selecting Leaders on the Basis of Personality," *Human Relations*, **7**, 493-508 (1954)
30. Cleland, S., *The Influence of Plant Size on Industrial Relations* (Princeton University Press, Princeton, N. J., 65 pp., 1955)
31. Clements, F. E., Bayton, J. A., and Bell, H. P., "Method of Single Stimulus Determinations of Taste Preference," *J. Appl. Psychol.*, **38**, 446-51 (1954)
32. Comrey, A. L., High, W., and Wilson, R. C., "Factors Influencing Organizational Effectiveness. VI. A Survey of Aircraft Workers," *Personnel Psychol.*, **8**, 79-100 (1955)
33. Comrey, A. L., Pfiffner, J. M., and High, W., "Factors Influencing Organizational Effectiveness. V. A Survey of District Rangers," *Personnel Psychol.*, **7**, 533-48 (1954)
34. Cozan, L. W., "Ratings of Specific Aspects of Job Performance Versus Over-All Ratings," *J. Personnel Administration and Industrial Relations*, **1**, 105-9 (1954)
35. Davis, L. E., and Canter, R. R., "Job Design," *J. Ind. Eng.*, **6**, 61-64 (1955)
36. Davis, L. E., Canter, R. R., and Hoffman, J., "Current Job Design Criteria," *J. Ind. Eng.*, **6**, 1-7 (1955)
37. Dean, L. R., "Social Integration, Attitudes, and Union Activity," *Ind. Labor Relations Rev.*, **8**, 48-58 (1954)
38. Dean, L. R., "Union Activity and Dual Loyalty," *Ind. Labor Relations Rev.*, **7**, 526-36 (1954)
39. Denton, J. C., "Building a Forced-Choice Personality Test," *Personnel Psychol.*, **7**, 449-60 (1954)
40. Di Vesta, F. J., "Instructor-Centered and Student-Centered Approaches in Teaching a Human Relations Course," *J. Appl. Psychol.*, **38**, 329-35 (1954)
41. Edgerton, H. A., "Some Needs in Training Research," *Personnel Psychol.*, **8**, 19-26 (1955)

42. Eriksen, C. W., "Partitioning and Saturation of Visual Displays and Efficiency of Visual Search," *J. Appl. Psychol.*, **39**, 73-77 (1955)
43. Fisher, W. E., "Interdisciplinary Thinking and Industrial Relations Research," *J. Personnel Administration and Industrial Relations*, **1**, 177-90 (1954)
44. Fitzpatrick, R., and Hahn, C. P., "Personnel Research in Industry: Its Present Scope and Applications," *Personnel*, **31**, 422-28 (1955)
45. Flanagan, J. C., "Job Element Aptitude Classification Tests," *Personnel Psychol.*, **7**, 1-14 (1954)
46. Flanagan, J. C., "The Critical Incident Technique," *Psychol. Bull.*, **51**, 327-58 (1954)
47. France, R. R., *Union Decisions in Collective Bargaining* (Princeton University Press, Princeton, N. J., 49 pp., 1955)
48. French, J. W., "The Validity of Some Objective Personality Tests for a Leadership Criterion," *Educ. Psychol. Measurement*, **14**, 34-49 (1954)
49. Gaiennie, L. R., "Organization Control in Business," *J. Appl. Psychol.*, **38**, 289-92 (1954)
50. Garvey, W. D., and Knowles, W. B., "Pointing Accuracy of a Joy Stick without Visual Feedback," *J. Appl. Psychol.*, **38**, 191-94 (1954)
51. Ghiselli, E. E., and Brown, C. W., *Personnel and Industrial Psychology*, 2nd ed. (McGraw-Hill Book Company, Inc., New York, N. Y., 492 pp., 1955)
52. Ghiselli, E. E., "The Forced Choice Technique in Self Description," *Personnel Psychol.*, **7**, 201-8 (1954)
53. Ginzberg, E., "Perspectives on Work Motivation," *Personnel*, **31**, 43-49 (1954)
54. Ginzberg, E., Ed., *What Makes an Executive?* (Columbia University Press, New York, N. Y., 179 pp., 1955)
55. Glickman, A. S., "Effects of Negatively Skewed Ratings on Motivations of the Rated," *Personnel Psychol.*, **8**, 39-48 (1955)
56. Gomberg, W., *A Trade Union Analysis of Time Study*, 2nd ed. (Prentice-Hall, Inc., New York, N. Y., 318 pp., 1955)
57. Gordon, O. J., "A Factor Analysis of Human Needs and Industrial Morale," *Personnel Psychol.*, **8**, 1-18 (1955)
58. Guilford, J. P., Christensen, P. R., Bond, N. A., Jr., and Sutton, M. A., "A Factor Analysis Study of Human Interests," *Psychol. Monographs*, **68**, No. 375 (1954)
59. Guilford, J. P., "The Validation of an "Indecision" Score for Prediction of Proficiency of Foremen," *J. Appl. Psychol.*, **38**, 224-26 (1954)
60. Habbe, S., "Company Presidents View Executive Selection," *Management Record*, **17**, 134-36 (1955)
61. Habbe, S., *Recruiting and Selecting Employees* (National Industrial Conference Board, Inc., Studies in Personnel Policy, No. 144, New York, N. Y., 80 pp., 1954)
62. Haber, W., Harbison, F. H., Klein, L. R., and Palmer, G. L., Eds., *Manpower in the United States* (Harper & Brothers, New York, N. Y., 225 pp., 1954)
63. Haire, M., "Role-Perceptions in Labor-Management Relations: An Experimental Approach," *Ind. Labor Relations Rev.*, **8**, 204-216 (1955)
64. Halpin, A. W., "The Leadership Behavior and Combat Performance of Airplane Commanders," *J. Abnormal Social Psychol.*, **49**, 19-22 (1954)
65. Halpin, A. W., "The Leadership Ideology of Aircraft Commanders," *J. Appl. Psychol.*, **39**, 82-84 (1955)

66. Halsey, G. D., *Selecting and Developing First-Line Supervisors* (Harper & Brothers, New York, N. Y., 203 pp., 1955)
67. Harris, E. F., and Fleishman, E. A., "Human Relations Training and the Stability of Leadership Patterns," *J. Appl. Psychol.*, **39**, 20-25 (1955)
68. Hay, E. N., and Purves, D., "A New Method of Job Evaluation: The Guide Chart-Profile Method," *Personnel*, **31**, 72-80 (1954)
69. Hay, E. N., "Comparative Validities in Clerical Testing," *J. Appl. Psychol.*, **38**, 299-301 (1954)
70. Hearnshaw, L. S., "Attitudes to Work," *Occupational Psychol. (London)*, **28**, 129-39 (1954)
71. Herzberg, F., "An Analysis of Morale Survey Comments," *Personnel Psychol.*, **7**, 267-76 (1954)
72. Herzberg, F., Bouton, A., and Steiner, B. J., "Studies of the Stability of the Kuder Preference Record," *Educ. Psychol. Measurement*, **14**, 90-100 (1954)
73. Hollander, E. P., "Buddy Ratings: Military Research and Industrial Implications," *Personnel Psychol.*, **7**, 385-94 (1954)
74. Hollander, E. P., "Peer Nominations on Leadership as a Predictor of the Pass-Fail Criterion in Naval Air Training," *J. Appl. Psychol.*, **38**, 150-53 (1954)
75. Holtzman, W. H., and Sells, S. B., "Prediction of Flying Success by Clinical Analysis of Test Protocols," *J. Abnormal Social Psychol.*, **49**, 485-90 (1954)
76. Jacobs, R., and Traxler, A. E., "What Manner of Man is the Average Accountant?," *J. Accountancy*, **97**, 465-69 (1954)
77. Jenkins, W. L., and Karr, A. C., "The Use of a Joy-Stick in Making Settings on a Simulated Scope Face," *J. Appl. Psychol.*, **38**, 457-61 (1954)
78. Jennings, E. E., "Dynamics of Forced Leadership," *J. Personnel Administration and Industrial Relations*, **1**, 110-18 (1954)
79. Johnson, G. H., "An Instrument for the Measurement of Job Satisfaction," *Personnel Psychol.*, **8**, 27-38 (1955)
80. Kellogg, M. S., "Appraising the Performance of Management Personnel: A Case Study," *Personnel*, **31**, 442-55 (1955)
81. Kerr, W. A., "Dual Allegiance and Emotional Acceptance-Rejection in Industry," *Personnel Psychol.*, **7**, 59-66 (1954)
82. Kirchner, W. K., and Dunnette, M. D., "Attitudes Toward Older Workers," *Personnel Psychol.*, **7**, 257-66 (1954)
83. Kirchner, W. K., and Dunnette, M. D., "Survey of Union Policy Toward Older Workers," *J. Personnel Administration and Industrial Relations*, **1**, 156-58 (1954)
84. Kunin, T., "The Construction of a New Type of Attitude Measure," *Personnel Psychol.*, **8**, 65-78 (1955)
85. Langmuir, C. R., "Cross-Validation," *Test Service Bulletin of the Psychological Corporation*, No. 47, 1-4 (1954)
86. Layton, W. L., "Interest Measurement. Theory and Research on the Strong Vocational Interest Blank: A Conference Report," *J. Counseling Psychol.*, **2**, 10-12 (1955)
87. Lester, R. A., *Hiring Practices and Labor Competition* (Princeton University Press, Princeton, N. J., 108 pp., 1954)
88. Levine, P. R., and Wallen, R., "Adolescent Vocational Interests and Later Occupation," *J. Appl. Psychol.*, **38**, 428-31 (1954)

89. Lewinski, R. J., "Psychological Appraisal of Executive Personnel," *J. Personnel Administration and Industrial Relations*, **1**, 44-59 (1954)
90. Lincoln, R. S., "Rate Accuracy in Handwheel Cranking," *J. Appl. Psychol.*, **38**, 195-201 (1954)
91. Littman, R. A., and Manning, H. M., "A Methodological Study of Cigarette Brand Discrimination," *J. Appl. Psychol.*, **38**, 185-90 (1954)
92. Mahler, W. R., and Frazier, G., "Appraisal of Executive Performance: The 'Achilles Heel' of Management Development," *Personnel*, **31**, 429-41 (1955)
93. Malm, F. T., "Hiring Procedures and Selection Standards in the San Francisco Bay Area," *Ind. Labor Relations Rev.*, **8**, 231-52 (1955)
94. Mandell, M. M., *A Company Guide to the Selection of Salesmen* (American Management Association, New York, N. Y., 161 pp., 1955)
95. Mandell, M. M., and Duckworth, P., "The Supervisor's Job: A Survey," *Personnel*, **31**, 456-61 (1955)
96. Mann, F., and Dent, J., *Appraisals of Supervisors* (University of Michigan Press, Ann Arbor, Mich., 39 pp., 1954)
97. Massarik, F., and Brown, P., "Social Research Faces Industry," *Personnel*, **30**, 454-61 (1954)
98. McArthur, C., "Long-Term Validity of the Strong Interest Test in Two Subcultures," *J. Appl. Psychol.*, **38**, 346-53 (1954)
99. McCormick, E. J., and North, W. E., "The Analysis of an Experimental Job Evaluation System as Applied to Enlisted Naval Jobs," *J. Appl. Psychol.*, **38**, 233-37 (1954)
100. McGehee, W., and Livingstone, D. H., "Persistence of the Effects of Training Employees to Reduce Waste," *Personnel Psychol.*, **7**, 33-40 (1954)
101. McQuitty, L. L., Wrigley, C., and Gaier, E. L., "An Approach to Isolating Dimensions of Job Success," *J. Appl. Psychol.*, **38**, 227-32 (1954)
102. Meehl, P. E., *Clinical vs. Statistical Prediction* (University of Minnesota Press, Minneapolis, Minn., 149 pp., 1954)
103. Minnesota State Employment Service in Cooperation with the U. S. Employment Service, U. S. Department of Labor, Washington, D. C., "Standardization of the GATB for the Occupation of Tabulating Machine Operator," *J. Appl. Psychol.*, **38**, 297-98 (1954)
104. Mintz, A., "Time Intervals Between Accidents," *J. Appl. Psychol.*, **38**, 401-6 (1954)
105. Moore, D. G., and Renck, R., *The Professional Employee in Industry: The Unhappy Engineers* (School of Business Publications IV, The University of Chicago, Chicago, Illinois, 9 pp., 1955)
106. Mosel, J. N., "Response Reliability of the Activity Vector Analysis," *J. Appl. Psychol.*, **38**, 157-58 (1954)
107. Mosel, J. N., and Tsacnaris, H. J., "Evaluating the Supervisor Training Program," *J. Personnel Administration and Industrial Relations*, **1**, 99-104 (1954)
108. Muckler, F. A., and Matheny, W. G., "Transfer of Training in Tracking as a Function of Control Friction," *J. Appl. Psychol.*, **38**, 364-67 (1954)
109. Nagle, B. F., "Productivity, Employee Attitudes and Supervisory Sensitivity," *Personnel Psychol.*, **7**, 219-34 (1954)
110. Noetzel, A. J., Jr., "Preparation of Industrial Workers for Retirement," *J. Personnel Administration and Industrial Relations*, **1**, 31-43 (1954)
111. Otis, J. L., and Leukart, R. H., *Job Evaluation* (Prentice-Hall, Inc., New York, N. Y., 532 pp., 1954)

112. Owens, W. A., Jr., "A Reply to Drs. Peck-Stephenson," *J. Appl. Psychol.*, **38**, 371-72 (1954)
113. Peck, R. F., and Stephenson, W., "A Correction of the Clark-Owens Validation Study of the Worthington Personal History Technique," *J. Appl. Psychol.*, **38**, 368-70 (1954)
114. Peck, R. F., and Thompson, J. M., "Use of Individual Assessments in a Management Development Program: A Case Study," *J. Personnel Administration and Industrial Relations*, **1**, 79-98 (1954)
115. Peck, R. F., and Worthington, R. E., "New Technique for Personnel Assessment," *J. Personnel Administration and Industrial Relations*, **1**, 23-30 (1954)
116. Purcell, T. V., "Dual Allegiance to Company and Union-Packinghouse Workers. A Swift-UPWA Study in a Crisis Situation, 1949-1952," *Personnel Psychol.*, **7**, 48-58 (1954)
117. Roe, A., "A New Classification of Occupations," *J. Counseling Psychol.*, **1**, 215-20 (1954)
118. Rosen, H., "Dual Allegiance: A Critique and a Proposed Approach," *Personnel Psychol.*, **7**, 67-71 (1954)
119. Scales, E. M., and Chapanis, A., "The Effect on Performance of Tilting the Toll-Operator's Keyset," *J. Appl. Psychol.*, **38**, 452-56 (1954)
120. Scott, W. D., Clothier, R. C., and Spriegel, W. R., *Personnel Management*, 5th ed. (McGraw-Hill Book Co., Inc., New York, N. Y., 690 pp., 1954)
121. Seybold, G., *Personnel Practices in Factory and Office* (National Industrial Conference Board, Inc., Studies in Personnel Policy, No. 145, New York, N. Y., 128 pp., 1954)
122. Seligson, H., and Brooks, D., "The Employment Interview as Seen by Job Applicants," *Personnel J.*, **33**, 141-43 (1954)
123. Siegel, A. I., "An Experimental Evaluation of the Sensitivity of the Empathy Test," *J. Appl. Psychol.*, **38**, 222-23 (1954)
124. Simpson, R. G., *Case Studies in Management Development* (American Management Association, New York, N. Y., 140 pp. 1954)
125. Spector, A. J., "Influences on Merit Ratings," *J. Appl. Psychol.*, **38**, 393-96 (1954)
126. Stagner, R., "Dual Allegiance as a Problem in Modern Society," *Personnel Psychol.*, **7**, 41-47 (1954)
127. Steele, E., Myles, W. R., and McIntyre, S. C., "Unionism and Personnel Practices in the Southeast," *Ind. Labor Relations Rev.*, **8**, 253-64 (1955)
128. Stessin, L., "Labor Relations," *Forbes Magazine*, **27** (April 1, 1955)
129. Stolz, R. K., "Getting Back to Fundamentals in Executive Development," *Personnel*, **30**, 434-44 (1954)
130. Stryker, P., *A Guide to Modern Management Methods* (McGraw-Hill Book Co., Inc., New York, N. Y., 300 pp., 1954)
131. Taft, R., "The Ability to Judge People," *Psychol. Bull.*, **52**, 1-23 (1955)
132. Taylor, E. K., Schneider, D. E., and Clay, H., "Short Forced-Choice Ratings Work," *Personnel Psychol.*, **7**, 245-52 (1954)
133. Teel, K. S., and DuBois, P. H., "Psychological Research on Accidents: Some Methodological Considerations," *J. Appl. Psychol.*, **38**, 397-400 (1954)
134. Thorndike, R. L., "Who Will Be Successful 10 Years from Now?," *American Management Association Personnel Series No. 163*, 3-14 (1955)
135. Tiffin, J., and Winick, D. M., "A Comparison of Two Methods of Measuring the

- Attention-Drawing Power of Magazine Advertisements," *J. Appl. Psychol.*, **38**, 272-75 (1954)
136. Van Zelst, R. H., "The Effect of Age and Experience upon Accident Rate," *J. Appl. Psychol.*, **38**, 313-17 (1954)
137. Wallace, S. R., Jr., and Weitz, J., "Industrial Psychology," *Ann. Rev. Psychol.*, **6**, 217-50 (1955)
138. Webb, W. B., "The Problem of Obtaining Negative Nominations in Peer Ratings," *Personnel Psychol.*, **8**, 61-64 (1955)
139. Wherry, R. J., Campbell, J. T., and Perloff, R., "A Factor Analysis of Officer Qualification Variables," *Personnel Psychol.*, **8**, 49-60 (1955)
140. Wherry, R. J., "An Orthogonal Re-rotation of the Baehr and Ash Studies of the SRA Employee Inventory," *Personnel Psychol.*, **7**, 365-80 (1954)
141. Whyte, W. H., Jr., "The Fallacies of 'Personality Testing,'" *Fortune*, **50**, 117-21, 204-8 (1954)
142. Wilson, R. C., High, W. S., Beem, H. P., and Comrey, A. L., "Factors Influencing Organizational Effectiveness. IV. A Survey of Supervisors and Workers," *Personnel Psychol.*, **7**, 525-32 (1954)
143. Wilson, R. C., High, W. S., and Comrey, A. L., "An Iterative Analysis of Supervisory and Group Dimensions," *J. Appl. Psychol.*, **39**, 85-91 (1955)
144. Worbois, G. M., and Kanous, L. E., "The Validity of the Worthington Personal History for a Sales Job," *Personnel Psychol.*, **7**, 209-18 (1954)

# STATISTICAL THEORY AND RESEARCH DESIGN<sup>1,2</sup>

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## THEORY OF STATISTICAL DECISIONS

The invention and development of the theory of statistical decisions beginning with Abraham Wald has restructured the body of statistical theory. As time passes two trends can be expected to strengthen: one is the justification or rejection of old statistical methods from the point of view of decision theory; the other is the solution of new problems (and the better solution of old ones) via a decision-theoretic approach. A good fraction of the statistical literature (in the period under review) interesting to psychologists appears to demonstrate, happily, the impact of decision theory on applied statistics.

A bare skeleton of the problem treated in decision theory is as follows. A person has available to him a set of possible actions of which he must choose one. Which action he would prefer to take depends upon what the "true state of nature" is (e.g., upon the unknown value of some parameter). His preferences among the actions are implied by a "loss function" which defines the loss (numerically, in terms of "utility") attaching to each possible action taken in the presence of each possible state of nature. He has some specified degree (which can range from none to complete certainty) of knowledge of what the state of nature is and can obtain further information about the state of nature through taking observations at a cost. This will, in general, enable him to choose an action which will comport better with the true state of nature, reducing the loss associated with his choice of action, at the same time as he incurs a cost for taking the observations. The decision problem is: given the loss function, the set of possible actions, the set of possible states of nature, his a priori information about the state of nature, and the cost of taking observations, what is a rational mode of behavior? This general formulation, upon sufficient reflection, can be seen to subsume estimation (by points, and by intervals), classification, tests of hypotheses, and indeed any statistical problem which requires an action, or a decision, as its answer.<sup>3</sup>

<sup>1</sup> The survey of the literature pertaining to this review was completed in May, 1955.

<sup>2</sup> The following abbreviation is used in this chapter: c.d.f. (cumulative distribution function).

<sup>3</sup> The problem is formulated here in less than its full generality; choice among which experiments to perform can be allowed to enter into the consideration of action, losses, and costs.



From this point of view several aspects of a statistical problem come into prominence: (a) What are the actions which are under consideration? (b) How can the losses attributable to taking inappropriate actions be characterized? (c) How is a priori information to be utilized? (d) How is the cost of experimentation or investigation to be balanced against the advantage accruing from making informed decisions? These are very general questions and are often difficult to answer in any given problem setting. Nonetheless each of these points has arisen or been treated in at least one interesting and important paper during the year under review.

When several experimental conditions are compared simultaneously, as in a typical analysis of variance experiment, the traditional statistical methods have enabled a worker to choose between the two actions, "Conclude that the treatments are equivalent in their effects" and "Conclude that the treatments are not equivalent in their effects." Rarely does this set of two possible actions correspond to the set of actions from which he will actually choose. Depending on the outcome of the experiment (and the purposes for which it was undertaken) he may select some one treatment as best, or he may select several of the treatments as worst and as deserving no further study, or he may conclude that a certain subset of treatments actually constitute a natural group in contrast to another subset from which they are different, or he may compare only certain pairs of treatments, etc.

Bechhofer, Dunnet & Sobel (6) give a procedure for ranking three means when the data come from normal distributions with common unknown variance. It is a two-sample procedure analogous to Stein's (79) which enables the experimenter to take sufficiently many observations to ensure (with assigned probability,  $1-\alpha$ ) that the sample ranking will be correct if the true differences exceed a preassigned "practically important" amount  $\delta^*$ . The sample size, in addition to depending on  $\alpha$  and  $\delta^*$  is a random variable (whose expectation can be computed). A related and similar procedure for merely selecting the largest of the three means is given. Tables necessary for the test are found in the same volume in a second paper written by Dunnet & Sobel (32). A similar problem which can arise is that of ranking, or partially ranking, a set of normal populations with respect to their variances; Bechhofer & Sobel treat this problem (7) giving single sample procedures for achieving either of the following goals:

Goal I: of  $k$  populations choose those  $t$  (a number set before the experiment) with the smallest variances

Goal II: same as goal I, but in addition rank among themselves the  $t$  populations with smallest variances.

The probability of reaching  $c$  correct ranking under either goal depends upon the size of the ratios of the population variances. Tables are given which permit choosing sample sizes to ensure (at assigned probability level) reaching the correct decision if the actual variances differ by ratios of specified size or more. The tables treat all the three-sample problems which fall under either goal and also the problem of choosing the smallest of four variances.

In many  $k$ -sample problems the experimenter may not actually care about ranking the treatments; he may be more interested in estimating the differences among various combinations of the means. This is a set of possible actions long acknowledged by statisticians but until recently not well treated. Common practice was to construct a  $t$ -confidence interval for any interesting linear contrast among the means. At the same time it was recognized that this procedure would tend to generate artificial "significant differences" as the number of treatments in the same experiment was increased. Tukey (88) gave a procedure for simultaneously making all possible confidence statements about linear contrasts among the means, with confidence  $1-\alpha$  that all statements were correct; the procedure applied to balanced experiments. Scheffé (76) later gave another procedure which could be applied to experiments even if not balanced. Both procedures result in confidence intervals exactly like those ordinarily constructed except that in place of a percentage point of the  $t$  distribution, one uses a percentage point from a distribution which involves two parameters, the degrees of freedom for error and the number of treatments in the experiment. Both give longer confidence intervals than those based on the  $t$  distribution; and the lengths of the confidence intervals, as well as their possible number, grows with the number of treatments. The upshot, using these methods, is that the experimenter need no longer fear that some or all of his significant results have arisen merely from the fact that he made many comparisons, but at the same time any particular comparison has attached to it a wide confidence interval. Duncan (30) offers what is apparently a compromise procedure which keeps some of the advantages, and some of the disadvantages, of the old and of the new. The procedure is offered for balanced experiments and appears complicated. Its properties, such as power, and indeed, level of significance seem difficult to state.

In a balanced experiment either Tukey's procedure (based on the distribution of the range) or Scheffé's (based on the  $F$  distribution) will allow the construction of all possible contrasts among the means with preassigned simultaneous confidence that all intervals are true; but they do not yield identical confidence intervals. Tukey-intervals will be shorter for contrasts which are of the form,  $\mu_i - \mu_j$ , that is, where the contrast estimated is a pairwise difference between means; Scheffé-intervals will be shorter for contrasts which compare the average of, say, half the means with the average of the other half. These considerations point up the fact that where an experimenter knows that where a special kind of contrast among the means will be of interest he should plan to use a simultaneous estimation procedure which is peculiarly precise for that type of simultaneous contrast.

Halperin *et al.* (45) have given tables which enable simultaneous estimation of a certain sort of differences which may be of interest in some investigations. If the experimenter wishes to identify those treatments whose means lie above or below the average of the means of treatments used in the experiment, he would use the tables presented there. It enables the identification

of "outlying means." The same tables may be applicable in identifying outlying observations where a question arises as to the validity of an observation. Use of the tables is illustrated in the paper.

A not infrequent type of experiment in which many contrasts are examined routinely is the  $2^k$  factorial. Here the number of contrasts grows rapidly with  $k$ , and the  $t$  tests ordinarily used can be viewed with real suspicion. The "simultaneous" treatment of the problem can be undertaken for  $k=2$  and  $k=3$  with the use of tables given by Pillai & Ramachandran (73). In their Table III are presented the upper 5 per cent points of a statistic  $U_n = |X_n/s|$  defined as the ratio of the largest (in absolute value) of  $n$  independent zero-mean normal random variables to  $s$ , an independent  $\nu$ -degree-of-freedom estimate of the standard deviation. In a  $2^k$  factorial the  $2^k$  treatment means are combined in various ways to yield  $2^k - 1$  estimated effects, which under the null hypothesis have zero mean. Thus if  $k=2$ , then  $2^2 - 1 = 3$  is the value of  $n$  appearing in  $U_n$ ; if  $k=3$  then  $n=7=2^3 - 1$ . Unfortunately only a few values are tabulated. The upper 5 per cent points are given for  $n=1(1)8$  and for  $\nu=5(5) 20, 24, 30, 40, 60, 120$ . An illustration of the use of the tables is as follows. Suppose that 24 subjects have been divided at random into 8 groups of 3, to each of which groups was assigned a different one of the eight treatment combinations arising from the combinations of high and low levels of three factors A, B, and C. Let the resulting data lead to the analysis of variance in Table I. Entering Table III in (73) we find the values 3.06 for  $n=7, \nu=15$  and 2.97 for  $n=7, \nu=20$ ; interpolating approximately we take the value 3.04 for  $n=7, \nu=16$ . (In some parts of their table graphical interpolation would be preferable.) Then each effect (such as 2.1 for A) which is in absolute value more than 3.04 times as large

TABLE I  
ANALYSIS OF VARIANCE FOR A  $2^3$  FACTORIAL (FICTITIOUS DATA)

Source	Sum of Squares	<i>d.f.</i>	Mean Square
Treatments	19.88	7	2.84
A (2.1) <sup>2</sup>	4.41		
B (-.1) <sup>2</sup>	.01		
C (-3.5) <sup>2</sup>	12.25		
AB (.4) <sup>2</sup>	.16		
AC (1.3) <sup>2</sup>	1.69		
BC (-.6) <sup>2</sup>	.36		
ABC (1.0)	1.00		
Error (within groups)	18.08	16	1.13

$$F = \frac{2.84}{1.13} = 2.513$$

$$F_{7,16}^{.05} = 2.66$$

as  $s = 1.06 = \sqrt{1.13}$  is adjudged significant, and all such judgments are made together with joint confidence .95. In our example only C is significant. Since the  $-3.5$  appearing in that single degree of freedom is actually (by the ordinary formulas for analysis of factorial experiments) the average difference  $\hat{\Delta}_C$  between the high and low levels of C, multiplied by  $3 \times 2$  (in general  $r \times 2^{k-2}$ ) we can quickly obtain a confidence interval for  $\Delta_C$  as follows:

$$\begin{aligned} -3.5 - (3.04)(1.06) &\leq \sqrt{r \cdot 2^{k-2}} \Delta_C \leq -3.5 + 3.04(1.06) \\ \frac{-3.5}{\sqrt{r \cdot 2^{k-2}}} - 3.04 \frac{1.06}{\sqrt{r \cdot 2^{k-2}}} &\leq \Delta_C \leq \frac{-3.5}{\sqrt{r \cdot 2^{k-2}}} + 3.04 \frac{1.06}{\sqrt{r \cdot 2^{k-2}}} \\ -1.43 - 3.04 \frac{1.06}{\sqrt{6}} &\leq \Delta_C \leq -1.43 + 3.04 \frac{1.06}{\sqrt{6}} \\ -1.43 - 1.315 &\leq \Delta_C \leq -1.43 + 1.315. \end{aligned}$$

There are two interesting things to note about this example. First, although the  $F$  ratio is not significant we have found a statistically significant effect; this can happen with any of the simultaneous procedures except Scheffé's and in no way invalidates the confidence interval or significance test. It occurs because the  $F$  test, being fully "general purpose" is less sensitive to any particular class of difference than is a "tailor made" test. Second, if the single degree of freedom for A were slightly larger it would be significant with a  $t$  test, but by no means according to the present test. This points up the lack of conservatism of the  $t$  test where many hypotheses are tested in the same experiment.

Finally, in connection with these tables it may be said that whenever the experimenter has  $n+1$  treatments, and a uniquely natural (before-the-experiment) way of breaking the treatment sum of squares into  $n$  orthogonal degrees of freedom, he should use these tables to ensure with confidence .95 that all  $n$  of his confidence statements are true. An example is the case where the treatments are equally spaced levels of one factor and the subdivision into orthogonal polynomials is natural.

All of the multiple decision procedures discussed above reflect the increasing attention being paid to the question "What are the relevant actions from which the investigator is to choose?" Central to the still simmering discussion of one- versus two-tailed tests are the nature of loss functions and the utilization of a priori information.

Burke (18) objects to applying one-tailed tests to scientific hypotheses partly because of fear of abuse and partly because he feels that when the theory is wrong and the data are right, publication may be in order despite a "not-significant" verdict from the one-tailed test. Jones (51) emphasizes that there are two situations where a one-tailed test is the only correct thing to use. One of these is in trying a new technique, which if better than the one presently used will replace it. The propriety of a one-tailed test here arises from the fact that since no loss attaches to mistaking "equal" for worse, or vice versa, there is no need for trying to decide whether the new method

is actually worse. The second situation is when the verification of a "one-sided theory" is sought. The propriety of a one-tailed test here follows immediately from the fact that if a theory predicts an increase then only an increase can tend to verify the theory. The experimenter should clearly use a one-tailed test if he is either (a) certain that if the treatment affects the distribution of a random variable at all it can affect it only in the hypothesized direction, or (b) indifferent to overlooking valid phenomena of a type different from his expectations. In point of fact the experimenter ordinarily has available the possible action "Do a second experiment," and this is a relevant part of the problem which should be taken into account in choosing levels of significance, deciding between one- and two-sided tests, etc.

It is the feeling of this writer that in the early phases of an inquiry when there is little *a priori* information regarding the effects and interactions of the variables, little will be proved, though much may be learned, and two-sided tests will be the order of the day, and that actually two-sided confidence intervals will be even more fruitful. As information accrues and problems are sharpened and theories knit, there will be more and more reason to use one-sided tests. In leaving this topic we quote a common-sense remark of Mosteller & Bush (66).

As for a related topic of one-sided versus two-sided tests, we think there are plenty of situations in which it is appropriate to test for directionality, but a factor of two in the significance level is scarcely worth arguing about. If it is a question of deciding between 0.05 and 0.10, the experiment was not ecstatically conclusive anyway.

The compelling relevance of consciously, and correctly, taking *a priori* information into account is forcibly illustrated in a stimulating paper by Meehl & Rosen (63). They point out how the intelligent use of a diagnostic criterion, or a psychometric cutting score, etc., depends upon properly relating it to the actuarial rates which also characterize the group. The example is offered where every member of the population is in one of two classes (say A and B). A test is available which gives a positive reading for 86 per cent of A's and for only 20 per cent of B's. We now test a subject and observe "positive," should we conclude that the subject is an "A"? The correct answer depends on the percentage of A's in the population; if for example 10 per cent of the population is in class A, we should answer "No" for the chances are two to one he is a B, even though positive. This is an elementary, and entirely correct, application of Bayes' theorem; it points out that to use additional information is not necessarily to take advantage of it. Any diagnostic test has two error rates; the probability of a false positive and the probability of a false negative. They offer simple numerical examples which illustrate that if positive cases are relatively few, then a change in the test which greatly reduces the rate of false negatives and only slightly increases the rate of false positives can be ruinous. [This general point is brought out

most clearly in an excellent paper of Dunn & Greenhouse (31) which despite its specialized title should prove valuable in psychology; it includes a clear statistical appendix.] Meehl & Rosen have not just raised disquieting thoughts, they have shown how the intelligent application of a cutting score absolutely depends upon knowing the relevant actuarial facts (which they call base rates) about two groups: (a) The group on which the normative data for the test were obtained. (b) The group on which it is being applied. They argue convincingly that doing the necessary record searching and record keeping to establish these base rates is a task of the first importance. One naturally feels that an even more adequate formulation of this problem would be obtained by taking explicit account of the relative gravity of the two kinds of errors which can be committed in applying a cutting score.

An aspect of nearly every statistical problem is cost. Sometimes ascertaining the costs of experimentation would be very difficult; other times it would not. But it is always a factor, even if unseen. In fact it is almost solely in these terms that sequential analysis can be justified. Somerville (78) sets himself a problem of choosing the optimum sample size  $n(k+1)$  for comparing  $k+1$  treatments which yield identical random variables but for translation. He takes the cost of experimentation to be a linear function of  $n$ , and the loss from erroneously choosing a treatment with mean  $\theta_j$  being  $\Delta_j$  units less than the largest of the  $k+1$  means as  $\Delta_j/N$ . The interpretation is that the comparison of the  $k+1$  treatments on a "pilot" scale results in the selection of one treatment which is then used on the full scale, that is, on  $N$  cases. The problem is, on how large a scale should the "pilot" work be done? Formulas and tables are given, the basic result under normality assumptions is that  $n$  should be proportioned to  $N^{2/3}$ , to the standard deviation, and to the reciprocal of the cost-per-unit of experimentation.

Grundty *et al.* (42) take up another problem the essence of which is economically to balance the cost of obtaining further information against the advantage of using the additional information. They pose and solve (in the framework of fiducial inference) the following problem. The experimenter must decide whether or not to adopt a new process which involves a known unit cost  $c$ ; he does not know the value of  $\eta$ , the unit increase in yield characteristic of the process. If the process is adopted then the gain to the investigator is  $(\eta - c)k'$  where  $k'$  is a known constant reflecting the projected scale of application; of course, if  $c > \eta$  the quantity  $(\eta - c)k'$  is a loss. The experimenter pays  $k$  units per experiment. He performs an initial experiment, obtaining an observation  $y$  (assumed normal, with known variance  $\sigma^2$ ). The problem is how many observations should he take (and pay for) in order to gather all the data he will use in deciding whether or not to adopt the new process?

It is not likely that either of the two papers just cited will find immediate sweeping applications in psychology, but they are indicative of a class of problems, which psychologists do experience, now coming under statistical

treatment. It is fair to say that the major portion of work to date in decision theory has not been centered on applications; the theory has received the bulk of the attention. A singularly nonmathematical, correct, modern, and yet intuitive treatment of the central issues in decision theory will be found in a paper by Girshick (38). He there introduces, beginning with first principles, the concepts of strategy, Bayes strategy, minimax strategy, admissible strategy, and complete classes of strategies. He points out that in many situations the notion of null hypothesis versus alternative hypothesis is an artificiality now outworn, that often the problem found by the investigator is more naturally, and more fruitfully, regarded as a question of choosing among alternative actions and utilizing observations on random variables in a rational way to assist in making sensible choices.

Another paper concerned with the question of decision making is that of Edwards (33). This is a long, careful, clear survey paper. He considers much material which is logically prior to the material in Girschick's paper. To posit both a loss function and a cost of experimentation requires the existence of a utility function. This is a matter whose nature is at once economic, psychological, and mathematical; Edwards gives a good treatment, including an historical survey. He briefly considers the theory of games and of statistical decisions. Throughout the paper there is emphasis on the nature of the central issues, their historical evolution, and upon recent experimental work bearing on them. The paper closes with a very comprehensive and valuable bibliography.

#### ANALYSIS OF VARIANCE

Some interesting extensions of the analysis of variance have already been taken up in the last section. We turn now to the assumptions underlying the analysis of variance. Box (12) investigates the effects of heterogeneous variance in a one-way design, under normality assumptions, and concludes that if equal numbers of observations are allocated to each treatment the distortion in the level of significance is not great for moderate variation in treatment-to-treatment variance. He considers his results as essentially confirmatory of similar results obtained by others. In a second paper Box (13) considers the two-way layout with one observation per cell and investigates the effects of errors being correlated within rows and also the effects of column-to-column heterogeneity of variance. With respect to column-wise heterogeneous variance he finds the probability of a significant  $F$  test for columns is somewhat increased, while the probability of a significant  $F$  test for rows is somewhat decreased; he states, "For moderate differences in variance neither effect is large." He then takes up the case when the errors between adjacent elements in a row are correlated (this correlation having a common value throughout the table). Such a model might approximate the facts when the "row" is an individual and the measurements are flicker fusion rates under different conditions. He finds that this correlation (assuming now homogeneous variance) has little effect on the  $F$  test for columns, but



greatly distorts the probability of obtaining a significant  $F$  test for rows, the direction of the distortion depending on whether the correlation is positive or negative. Graybill (41) points out that Hotelling's  $T^2$  gives an exact test for equality of column means in a randomized block (blocks are rows) design, even allowing correlation of errors within blocks and heterogeneity of variance between treatments (columns). The normality assumption is still needed, and it is assumed that correlations and variances are the same from block to block. A worked example is given. The calculations are arithmetically more complicated than for the analysis of variance, requiring the construction and inversion of a  $(t-1) \times (t-1)$  matrix where there are  $t$  treatments; but it seems clear that the method is applicable to many psychological problems now treated by the misapplication of the analysis of variance.

Every analysis of variance model (fixed effects) begins with the assumption that the expected values of all the observations can be expressed as additive combinations of some unknown parameters. This is often taken for granted, but it is a crucial assumption. Although the assumptions of homogeneity of variance, normality, and independence of errors all can be relaxed to some extent, under say the model of randomization, the assumption of additivity remains important (52). In the two-way analysis of variance nonadditivity simply means interaction; Tukey (87) some years ago gave a test for nonadditivity which can be applied to the two-way analysis of variance with one observation per cell. He has now (90) given a similar test which can be applied to the latin square design. He also sketches the method of constructing such a test for any design. Briefly the method is as follows: define  $\bar{y}_\alpha$  as the least squares estimate of  $y_\alpha$  under the model; then  $y_\alpha - \bar{y}_\alpha$  is just a residual in the ordinary sense of the word. Define  $Z_\alpha = C(\bar{y}_\alpha - C_1)^2$  where  $C$  and  $C_1$  are any convenient constants, e.g.,  $C = .001$  and  $C_1 = \bar{y}$ . Then perform an analysis of covariance with  $Z$  for the predictor variable. The sum of squares for regression on  $Z$  has a single degree of freedom, can be removed from the error sum of squares, and if significant by an  $F$  test against the remaining error, is evidence of nonadditivity.

Where evidence of nonadditivity is found, one may seek a transformation for the data so that the transforms are additive. Moore & Tukey (65) discuss this problem in terms of a particular example; they choose a transformation from among the many possible ones which can be written in the form:

$$y = (X + C)^p$$

where it is understood that for  $p=0$ ,  $y = \log(X + C)$ . The discussion is informative.

Mosteller & Bush (66) discuss the usefulness of transformations from other points of view, particularly with regard to the stabilization of variance. They stress the advantage of having a known variance for the transform used; it provides a useful check on the precision of experimental work. They discuss modifications of the square root and angular transforms and give tables in the case of the former.

In an interesting note on the problem of missing data in analysis of variance layouts Nelder (67) points out that when one constructs a fictitious observation,  $Z^*$ , to facilitate the unbiased estimation of the error variance he does not regard  $Z^*$  as an estimate of the value which the missing observation would have had, but nonetheless it is an estimate of the missing datum—it is the maximum likelihood estimate if the model holds. Hence if  $Z^*$  has an absurd value it may be regarded as a warning that additivity in the observed scale may not hold and that a transformation may profitably be sought.

Binder (8) takes up the important and vexing problem of when to pool the within-cells sum of squares with the interaction sum of squares in a two-way analysis of variance with multiple observations per cell. The experimenter always has available to him a rigorously correct test by never pooling the interaction and within-cells sum of squares. The disadvantage is that he may have few degrees of freedom for the denominator variance in his  $F$  test, which gives low power. It is conceivable that the experimenter could instead always pool the two sums of squares; in so doing he would always have more degrees of freedom, but the validity of his  $F$  tests would be chronically in question. A middle course is to compare the sizes of the mean squares for within and for interaction and only if they are not greatly different, pool the two sums of squares. Binder, reporting work of Bechhofer (5) and Paull (70), recommends the never-pool procedure unless there is a strong *a priori* assumption that interactions are either zero or definitely small.

Where such an *a priori* basis exists and a sometimes-pool procedure is in order, the experimenter exchanges some distortion in the over-all level of significance for some gain in power through increase in the degrees of freedom for the denominator of the  $F$  statistic. (It would appear that if there are already plenty of degrees of freedom in the appropriate unpooled error term then greed for more degrees of freedom is misplaced.)

The risks to be faced in using a sometimes-pool procedure (that is in making preliminary tests of the mean squares for within and for interaction) are different for the fixed effects model (Model I) and the components of variance model (Model II). In the former case, where the main effects and interactions are unknown fixed constants, the mean square within is the never-pool error term, and erroneously pooling tends to yield a too-large error term, giving too few significant results. In the latter case, where the main effects and interactions are random variables, the mean square for interaction is the never-pool error term and erroneously pooling tends to yield a too-small error term, giving too many significant results.

Binder presents rules for each model, which suggest what levels of significance to use for the preliminary test of whether to pool and for the final test of main effects. These rules control the distortion in the over-all level of significance and enable a gain in power of the over-all test.

Federer & Schlottfeldt (35) present a set of data for which an analysis of variance with quadratic covariance is carried out to advantage. They suggest that in some connections this method may be a reasonable alterna-

tive to a latin square design. Davies & Sears (28) present a three-factor experiment (one is time) in several unbalanced replications; there are missing observations; some effects are fixed, others are random. They attack this complicated (but somehow familiar-feeling) set of data with pluck and much good sense and arrive at a convincing analysis.

#### CHI-SQUARED AND CATEGORIZED VARIABLES

Cochran (24) gives an extended and meaty discussion of the use of the  $\chi^2$  test; he is especially concerned with modifications and extensions which are sensitive to natural alternatives which the investigator has in view. In testing the goodness of fit of a set of data to the binomial, to the Poisson, or to the normal he recommends the use of a moment test (e.g.,  $\Sigma(x_i - \bar{x})^2/\bar{x}$  for the Poisson) rather than the grouped frequencies  $\chi^2$  test. He shows how to construct and test individual degrees of freedom to detect linear trend or such other kind of nonfit as might be under suspicion. In applying the  $\chi^2$  test to contingency tables special procedures should be used, and are presented, when the rows or columns or both are ordered. If the  $\chi^2$  statistic is significant then the question why is it significant can be attacked by analyzing the statistic into meaningful components, which need not necessarily add up to the over-all value; or an additive decomposition (analogous to frequent practice in the analysis of variance) may be carried through whether or not the over-all test is significant. Methods are demonstrated. Issues and procedures in the combining of  $2 \times 2$  tables are considered. Recommendations on minimum cell frequencies are given. The paper closes with some recommendations about when not to use  $\chi^2$  but instead the analysis of variance of proportions (or their angular transforms).

Chernoff & Lehmann (22) point out that in a grouped-frequencies  $\chi^2$  test of goodness of fit the test statistic has the tabular  $\chi^2$  distribution if the estimated parameters used in computing expected frequencies are the maximum likelihood estimates computed from the cell frequencies. In the case of testing for normality the use of the mean and standard deviation of the observations themselves leads to systematically large values of the  $\chi^2$  statistic, and the probability of a significant result is artificially large. When there are few cells this effect may be an important one.

In sorting the elements of a sample into two classes there are two possible kinds of error. Let the probability of these two errors of classification be called  $\phi$  and  $\theta$ ; if both are zero then every element is certain to be classified correctly. Bross (16) examines the bias of the binomial estimate  $\hat{p}$  where they are not both zero. If the same classification method is applied to samples from two populations then the estimate of  $p_1 - p_2$  will be biased, but the test of their equality will have the nominal level of significance and will suffer a reduction in power.

Convenient computing methods for the decomposition of the  $\chi^2$  statistic in a contingency table are given by Kimball (55) who shows how to break an  $r \times s$  table down into  $(r-1)(s-1)$  individual  $2 \times 2$  tables.

Where two samples give estimates  $\hat{p}_1$  and  $\hat{p}_2$  of the binomial parameters

$p_1$  and  $p_2$  it is sometimes desired to speak of  $p_2$  as being larger than  $p_1$  by some percentage of  $p_1$ . Bross (15) gives a method of constructing a confidence interval for  $\theta = 100(p_2 - p_1)/p_1$ . If the confidence interval includes both positive and negative values then  $\hat{p}_1$  and  $\hat{p}_2$  are not significantly different, and conversely. The method of derivation assumes  $p_1$  and  $p_2$  to be sufficiently small, and the sample sizes sufficiently large, to justify the use of the Poisson approximation.

The problem of combining independent tests of significance has received some attention during the period under review. Mosteller & Bush (66) give a thoughtful three page discussion of the matter. They emphasize the absolute necessity for the various  $p_i$  actually to be independent; they review the rationale of Fisher's method for continuous variables. They discuss a method proposed by Stouffer *et al.* (81) which amounts to transforming each observed  $p_i$  to its corresponding unit normal deviate; the advantage is that various of the  $p_i$  can then be entered with greater or lesser weight, and since the distribution of a weighted sum of unit normal deviates is known to be normal with mean zero and variance equal to the sum of the squared weights, the combined test is easily made. Another method proposed by Gordon *et al.* (40) is pointed out. They show how one should take account of the directionality of the original test statistics in combining their associated  $p$ 's by Fisher's method. For illustration they consider three  $t$ 's with values  $-.70$ ,  $1.37$ , and  $2.23$  each with 10 degrees of freedom. They recommend the use of the one-sided probabilities of  $.75$ ,  $.10$ , and  $.025$  in applying Fisher's technique. The probability of the resulting  $\chi^2$  with six degrees of freedom may then be doubled or not as a two-sided or a one-sided test is desired. Similar considerations apply in the case of combining  $2 \times 2$  contingency tables (as the reader of Cochran's paper, *vide supra*, will find). They point out that if the  $p_i$  have arisen from discrete tests (as with the binomial for example) then the combined  $\chi^2$  will be artificially small. This problem was treated by Wallis (91) in the case of combining two  $p$ 's, one discrete and one continuous; he proposes that actually counting all possible joint outcomes must be undertaken where two or more of the  $p_i$  are discrete. Two papers on this problem do offer more pleasant methods, however. Consider the outcome of a sign test where there are five pairs and the null hypothesis is that the probability of a positive difference (+) is one half. Let us suppose that we take many + as the high end of the scale. Then the possible outcomes are:

	5+	4+	3+	2+	1+	0+
$F(X)$	$\frac{1}{32}$	$\frac{6}{32}$	$\frac{16}{32}$	$\frac{26}{32}$	$\frac{31}{32}$	$\frac{32}{32}$
$X$	1	2	3	4	5	6

Here the probabilities  $F(X)$  written below the outcomes may be interpreted according to the following statement: "6/32 is the probability of obtaining so high a result as 4 (or more) positive differences." The values of  $X$  range from 1 to  $N$  and order the outcomes from most extreme to least.

Lancaster (56) proposes to refer to the  $\chi^2_{2k}$  distribution not the statistic

$$\sum_{i=1}^k -2 \log F(X_i)$$

but rather

$$\sum_{i=1}^k W_i$$

$$\text{where } W_i = -2 \log \frac{F(X_i) + F(X_i - 1)}{2} \quad \text{if } X_i \neq 1$$

$$= 2 - 2 \log F(X_i) \quad \text{if } X_i = 1.$$

This procedure is little more trouble than the customary one, but it gives a combined statistic which is much more nearly distributed as  $\chi^2_{2k}$ . (It will be seen that it decreases each value of  $p_i$ , which a reading of Wallis' article shows is a step in the right direction.) There is still a slight bias (in the direction of two few significant results) which can become important if very many tests are to be combined. Lancaster also proposes another method which will be found in the same paper.

The basis of Fisher's method is to reject the null hypothesis if the product of the various  $p_i$  is sufficiently small (this is clearly the same as rejecting if the negative of the sum of their logarithms is too large). That the combined statistic has the distribution of  $\chi^2$  with  $2k$  degrees of freedom stems from the fact that the individual summands are independently (!) distributed as  $\chi^2$  with two degrees of freedom, and this in turn rests on the fact that if the null hypothesis is true, and the test statistic is continuously distributed, then  $p_i$  is uniformly distributed between 0 and 1. In a case such as the sign test above,  $p_i$  is clearly not uniformly distributed, and it is for this reason that Fisher's technique cannot be applied. Pearson (71) resolves the problem by making  $p_i$  continuous. We have already seen that the  $p_i$  tend to be too large. His proposal is, that upon observing  $X$  the investigator chooses with a table of random numbers a quantity which is uniformly distributed between  $F(X-1)$  and  $F(X)$  and then use the resulting  $p_i'$  (which must now be somewhat smaller than  $p_i$ ) in the ordinary Fisher procedure, which is now entirely valid. The proposed procedure does involve randomization after the experiment, to which various people react in various ways. His comments on this subject incidentally well repay the time spent in reading them.

In an interesting paper (10) Birnbaum considers Fisher's technique for combining independent tests, and two others, one of which was proposed by Karl Pearson and the other by Wilkinson (93). Wilkinson's test proposal is to convert each test statistic to its corresponding  $p_i$  and then reject the null hypothesis if sufficiently many (say  $r$  or more) of the  $p_i$  are less than a value  $c$ . Birnbaum regards these procedures from the vantage point of the theory of statistical decisions and is able to show (for all distributions in a wide class—those of Koopman form) that Pearson's test is inadmissible and that Wilkinson's is admissible if  $r$  is taken as one, but for larger values it is inadmissible.

ble. It would be useful to know for what distributions the proposals of Stouffer *et al.* are admissible.

Some of the oldest techniques in the young field of statistics have to do with construction of indices from contingency tables. It is easy to wonder in what circumstances which, if any, are appropriate. Goodman & Kruskal (39) have written a long paper in which they propose several new indices for contingency tables. In every case the index is proposed for some purpose, e.g., to measure the improvement in predicting a person's class membership on one scale as a result of knowing in which class he belongs on the other scale. The cases where the two "scales" are ordered and unordered are distinguished, and different statistical measures are offered for each. Indices of partial and multiple association in complex tables are offered. They deal throughout with the case where no underlying continuum can be assumed and treat separately ordered and unordered, symmetric and nonsymmetric problems. No distribution theory is given, though the authors indicate that some large sample distribution theory can be expected in the not too distant future. The emphasis on "What is this cross classification to be used for?" and the appropriateness of the suggested index for the elected purpose may make a strong and pleasant impression on the man who doesn't use coefficients in contingency tables because he doesn't know what they mean.

The twenty-ninth of 51 "unsolved problems of experimental statistics" listed by Tukey (89) is "How soon will we appreciate that the columns (or rows) of a contingency table usually have an order?" An example of ordered categories would be: "degeneration," "no change," "improvement," "strong improvement." All too commonly a  $\chi^2$  test is allowed to give the final verdict in such cases. As already mentioned Cochran considers modification of the  $\chi^2$  test for handling this case. A different approach where both classifications are ordered, or one is a dichotomy and the other is ordered is to use Kendall's  $\tau$  (53) coefficient with correction for ties; this reduces in the second case to the Wilcoxon (Mann-Whitney) test. Jonckheere (50) makes just this proposal and gives tables of exact significance points for  $k$  samples each of size  $m$  in the following cases:  $k=3$ ,  $m=2, 3, 4, 5$ ;  $k=4$ ,  $m=2, 3, 4$ ;  $k=5$ ,  $m=2, 3$ ;  $k=6$ ,  $m=2$ . For large samples a normal approximation is appropriate. For the case of a dichotomy with ordered categories a computing procedure for the Kendall-Wilcoxon-Mann-Whitney-Jonckheere-Festing test is demonstrated by Bross (17).

McGill (61) finds a relation between Shannon's measure of information and  $\chi^2$  statistics associated with tests of various hypotheses of independence in a three-way contingency table. He also gives a generous discussion of information theory with more than one information source transmitting.

Reiersøl (75) adapts Neyman's theory of BAN (best asymptotically normal) estimates to complicated layouts where the data are binomial trials, but the setup and hypotheses of interest are similar to those encountered in analysis of variance problems. The tests developed are easily applied and have intuitive appeal. In the final analysis experience with them and other applica-

ble methods will need to be compared in order to assess their worth in small samples.

### NONPARAMETRIC METHODS

Developments in this field include new procedures, tables to extend use of existing procedures, and results concerning the efficiency of certain well-known nonparametric methods. In addition there are two general treatments which will be commented on here. Blum & Fattu (11) give a survey of the recent literature with commentary. Mosteller & Bush (66) explain and illustrate with worked examples many of the most generally applicable methods. They give tables of significance values for several of these tests, which makes the treatment especially useful.

The problem of linear regression is attacked nonparametrically by Daniels (26) who considers the model:

$$y_i = \alpha + \beta x_i + \epsilon_i \quad i = 1, \dots, n$$

where the  $x_i$  are known without error and the  $\epsilon_i$  are independently and symmetrically distributed around 0, not necessarily in the same way. (The distribution of  $\epsilon_i$  is assumed to be continuous.) He gives a method (graphical) for obtaining a confidence region for the pair of parameters  $\alpha$  and  $\beta$ . He also gives a method for testing the hypothesis that  $\alpha$  and  $\beta$  have specified values  $\alpha_0$  and  $\beta_0$ . The test is performed as follows: for each of the  $n$  observations construct the difference,

$$(y_i - \alpha_0 - \beta_0 x_i) \quad i = 1, \dots, n$$

and then note the sign of the  $i^{\text{th}}$  difference and define  $s_i$  to be +1 or -1 as the sign of the difference is positive or negative. Now define  $n$  quantities

$$w_i = \sum_{j=1}^i s_j \quad i = 1, \dots, n.$$

Also let  $t$  stand for the number of  $s_i$  which are negative. Then for each observation construct  $m_i$  where  $m_i$  is the smaller of the two numbers  $(t + w_i)$  and  $[n - (t + w_i)]$ . The test statistic is  $m$ , the smallest of the  $n$  values  $m_i$ . It is impossible for  $m$  to exceed  $n/2$ ; a small value for  $m$  casts doubt on the truth of the hypothesis. Critically small values of  $m$  can be found from the probability distribution of  $m$  which is tabled in the paper for  $n = 3$  (1) 30. For large samples  $m$  is approximately normally distributed and rejection is called for at the 5 per cent level if

$$m < \frac{n}{2} - 1.512\sqrt{n}$$

and at the 1 per cent level if

$$m < \frac{n}{2} - 1.781\sqrt{n}.$$

The following example will serve as an illustration. Let the hypothetical



values of  $\alpha_0$  and  $\beta_0$  be 3.0 and 2.0 respectively and the observation be as given in Table II. Entries in the next to the last line, labeled  $t+w$ , are found by adding each entry in the row  $w$  to the value of  $t$ , which is four in this example since there are four negative values of  $s$ . Daniels indicates the extension of the method to multiple regression problems.

TABLE II  
ILLUSTRATIVE COMPUTATION FOR DANIEL'S REGRESSION TEST

	1	2	3	4	5	6	7	8	9	10	11
$x$ :	1.1	1.2	1.2	1.3	.9	1.4	1.5	1.7	.8	1.0	1.4
$y$ :	6.7	6.5	5.2	6.2	3.8	5.0	6.4	7.5	6.7	4.3	6.4
$y - \alpha_0 - \beta_0 x$ :	1.5	1.1	-.2	.6	-1.0	-.8	.4	1.1	2.1	-.7	.6
$s$ :	+1	+1	-1	+1	-1	-1	+1	+1	+1	-1	+1
$w$ :	1	2	1	2	1	0	1	2	3	2	3
$t+w$ :	5	6	5	6	5	4	5	6	7	6	7
$b - (t+w)$ :	6	5	6	5	6	7	6	5	4	5	4

The Kolmogorov-Smirnov test is well-known to psychologists. It tests the hypothesis that two samples have been drawn from the same continuous distribution by judging whether the two sample cumulative distribution functions differ at any point by a significantly large amount. The maximum difference between two cumulative distribution functions is not the only measure of discrepancy between them which can be used as a test statistic. The Cramer-von Mises  $\omega^2$  statistic is representative of another class of such test statistics. Analogues of these same tests may be used to test that a sample has been drawn from a population with a specified distribution. (Here the statistic measures the discrepancy between the sample c.d.f.<sup>2</sup> and the hypothetical c.d.f.) A shortcoming of all these one-sample tests in comparison with the  $\chi^2$  goodness of fit test is that they are not applicable (as  $\chi^2$  is) where the parameters of the hypothetical distribution must be estimated. Darling (27) makes an important theoretical attack on this problem where one parameter is to be estimated. It does not appear, however, that at this stage his results can be applied to practical problems. Malmquist (62) gives the distribution theory for certain generalizations of the Kolmogorov-Smirnov test and is able to calculate approximate efficiencies. Tsao (86) attacks a problem which fairly often arises in practice; one may be interested for practical reasons in testing for the identity of two distributions where he has not obtained all the data necessary to construct the sample c.d.f. because of the fact that observations are obtained in order of their size. For example, the random variable investigated may be  $t$ , the time needed for some event to occur (such as death of an animal in biological experiments). At any time  $T$  the values of  $t$  will have been observed for some members of both samples, but one must wait, possibly a long time, to observe all values in both samples. It is intuit-

tively clear (as well as true) that the Kolmogorov-Smirnov criterion is too strict where only the early parts of the two sample c.d.f.'s are compared. Tsao tables the probability distribution of the maximum difference in two "partial" c.d.f.'s in the case of equal samples  $m=n=3$  (1) 10, 15, 20, 30, 40 for various degrees of truncation.

The question of efficiency of nonparametric tests against normal alternatives was investigated by Dixon (29) who obtained exact results for small samples ( $m=n=3, 4, 5$ ). He found the Wilcoxon test, Kolmogorov-Smirnov test, and median test to have efficiencies descending in that order, and that the two former ones become gradually less efficient as the alternative under consideration is more remote from the null hypothesis. Mood (64) finds asymptotic efficiencies of  $3/\pi$ ,  $2/\pi$ , and 0 respectively for the Wilcoxon test, the median test, and the run test. He also proposes a rank test for dispersion and gives its asymptotic efficiency. He also finds the asymptotic efficiency of the run test against normal dispersion alternatives to be zero. Andrews (3) gives formulas which permit the evaluation of the asymptotic relative efficiencies of the  $F$  test, median test, and Kruskal-Wallis  $H$  test to one another for any assumed alternative continuous distribution. In the special case of normal alternatives the asymptotic relative efficiencies of the median test and  $H$  test compared with the  $F$  test are  $2/\pi$  and  $3/\pi$  respectively, as in the two-sample case.

A simple computing formula and a table of significance values for one form of the  $\omega^2$  test are given by Anderson & Darling (2). Epstein (34) gives tables which permit answering such questions as, "What is the probability that the third largest flood during the past 20 years will be exceeded at least once during the next 20?" (answer, .8846).

#### MISCELLANEOUS PROBLEMS IN STATISTICAL INFERENCE

The distribution of  $r_{pb}$ , the point-biserial correlation coefficient, is treated in two papers, both extending Lev's (58) results. Lev gave the distribution of  $r_{pb}$  for given fixed frequencies in the two dichotomous classes, and his results are stated in terms of the noncentral  $t$  distribution. Perry & Michael (72) have undertaken to make these results more accessible to psychologists by elucidation of operations with the noncentral  $t$  distribution. In a wide class of problems (perhaps the bulk of them) where  $r_{pb}$  arises naturally, the conditional distribution of  $r_{pb}$ , given the observed frequencies in the two classes, is of less interest than the unconditional distribution where these frequencies are regarded as random variables. In these cases Lev's distribution theory must be extended, and the Perry & Michael material is inapplicable. Tate (82) has made this extension, giving small-sample methods which use tables (64) of the power of the  $t$  test (a more conveniently used form of the noncentral  $t$  distribution) and also giving a large sample normal approximation. This approximation is quite complicated, but if one resists the temptation to solve a fourth degree equation and instead thoughtfully applies graphical methods, confidence intervals should be fairly readily constructible. In case

$p$ , the probability of classification into, say, the "high" class is .5, then a simpler normal approximation, involving an adaptation of Fisher's  $z$  transformation, is offered.

Fiske & Jones (37) give a discussion of the objectives, advantages, and general techniques associated with sequential testing of hypotheses. They direct the reader to relevant literature. They point out that sequential analysis is likely to be useful where the cost per observation is high. It is also true that methods are not likely to be useful where it takes a long time to generate one observation as would be the case, e.g., if the "treatment" related to admissions procedures and the random variable were success or failure in professional school. Anscombe (4) considers a problem which often arises, but is seldom faced, to wit, "What are the effects of using standard methods of analysis (which assume a predetermined fixed sample size) on my data when I actually stopped because we ran out of time (or money, or cases, or patience, or curiosity, or competent assistants, etc.)?" His findings are surprisingly comfortable. "We may suspect appreciable error in a fixed-sample-size analysis if . . . both:

1. The number of observations depends on the observations themselves and
2. The relative dispersion of the number of observations in repeated sampling [of the type implicitly employed] is not very small."

One might propose to obtain a confidence interval for  $\mu$ , the mean of a normal distribution, (with  $\sigma$  unknown) by sampling until  $(s_n t_{n-1}^{1-\alpha/2} / \sqrt{n}) \leq \frac{1}{2}l$ . This rule would assure the construction by ordinary  $t$  test methods of a confidence interval of length at most  $l$ , but there is no reason to suppose that the confidence coefficient would actually be  $1-\alpha$ . He finds that if  $l$  is small (so that the total sample size must be large) then the error is "of the same order as, but less in magnitude than, the error in replacing Student's distribution by a standard normal distribution."

Chernoff (21) investigates the asymptotic distribution of the likelihood ratio test statistic where one is testing a part (a  $k-1$  dimensional hypersurface) of the  $k$  dimensional parameter space against alternatives to one side of the hypothesis subspace, rather than against fully general alternatives. His results justify using the upper  $2\alpha$  point of the  $\chi^2$  distribution (with one degree of freedom) for an  $\alpha$ -level test of the one-sided hypothesis.

Birnbaum (9) gives a full and clear survey of the tests and estimates (both sequential and fixed sample size) which are associated with the Poisson distribution. The bibliography is an excellent guide to the literature on techniques which deal with the Poisson; but many interested readers will go no further than this paper which gives precise statements of results (though no proofs) and explicitly spells out procedures.

Mosteller & Bush (66) include in their survey chapter, already referred to several times, a section on problems and probabilities which arise in card-matching, agreement between two judges, etc.

When one actually uses normal probability paper and plots the sample

c.d.f. there is a problem as to just how the points should be plotted. Neither 0 per cent nor 100 per cent can be plotted at all; then if all points are to be entered, some adjustment must be made. Two adjustments which can be used are: (a) to decrease all numerators for the c.d.f. by  $\frac{1}{2}$  and (b) to use  $n+1$  for the denominator. Chernoff & Lieberman (23) show that whether one wishes to estimate  $\mu$  or  $\sigma$  he is poorly advised to use procedure (b), that procedure (a) is much better (and in fact very good). For small samples ( $n \leq 10$ ) they give instructions for plotting the points so as to yield optimum estimates of  $\mu$  or  $\sigma$ .

This section entitled "Miscellaneous Problems in Statistical Inference" could not properly omit comment on a curious, deep, and stimulating paper by Tukey (89). This is a paper which must be read, not abstracted. It is a pungently anti-cook book manifesto, which pleads for recognizing an unsolved problem as an unsolved problem; it pleads for identifying those unsolved problems now looked on with blind eyes. It enumerates 51 unsolved problems including such samples as the following: "What are we trying to do with goodness of fit tests?"; "What are appropriate logical formulations for item analysis?"; "What of regression with error in  $x$ ?". The asking of these questions is a process which somehow imparts some information to the reader.

#### SCALING, TESTING, AND CLASSIFICATION

A brief but surprisingly full critical review of literature (since 1951) in scaling is given by Lord (60). His treatment would almost justify the title "A Synopsis of the Present Status and Lines of Change in Scaling." Coombs (25) proposes a carefully structured generalization of the method of paired comparisons, which with consistent judgments leads to an ordered metric scale for a set of stimuli; the argument depends on the stimuli being points on a unidimensional continuum. Empirical checks are possible. Gulliksen (43) gives a least squares method for estimating simultaneously the scale values and discriminial dispersions of  $n$  stimuli, and the scale values of the boundaries of  $k+1$  linearly ordered response sets; this estimation problem arises where on  $N$  occasions  $n$  stimuli each are assigned to one of  $k+1$  linearly ordered response sets.

Loevinger (59) points to the fact that where a test is homogeneous (that is all inter-item correlations are accounted for by a single common factor) test reliability and test validity increase together to a point, after which further increase in test reliability is associated with a decrease in validity. This phenomenon is modified (but not negated) by length of test, difficulty of items, and dispersion of item difficulties. She proposes to call a property which (like reliability) is not monotonically related to test validity a "paradoxical property." Scalability (in the sense of Guttman's coefficient of reproducibility) is also a "paradoxical property." She poses the question "What are some nonparadoxical properties?" In a paper related to the matter Willis (94) suggests that when a test undergoes modification (removal and change

of items, etc.), its scalability may increase while at the same time the opportunity for nonfitting (in Guttman's sense) responses is reduced. He proposes a measure  $H$  of the possibility of nonfit which formally resembles the measure of entropy; he suggests that in comparing two versions of a test the difference in scalability should be considered together with the difference in  $H$ .

The following papers relating to paired comparisons are reviewed by title: Bradley (14), Hopkins (46, 47), Kendall (54), Hopkins & Gridgeman (48), Abelson & Bradley (1).

Tatsuoka & Tiedeman (83) in reviewing recent (and old) literature in the field of discriminant functions actually give a singularly clear and informative exposition of the classification problem and what is known (and not known) about solving it. Rao (74) examines the structure of classification problems and solutions from the viewpoint of modern principles of inference (including, of course, decision theory). Stoller (80) proposes a classification scheme, in one dimension, which is easy to apply and for which he exhibits optimum properties. His procedure is to choose for a cutting point in classifying a new observation that value of the variable for which the cumulative distribution functions of the two samples in hand lie furthest apart; this amounts to using as a cutting score that value for which the sum of the classification errors in the two samples would be a minimum. (Clearly this could be generalized to call for minimizing any weighted sum of the two kinds of errors.)

#### FACTOR ANALYSIS

The central core of factor analysis, that is, the very possibility of parsimony, is touched squarely by Guttman (44) who shows that a correlation matrix  $R$  (with 1's in the main diagonal) admits the possibility of parsimony (in the sense of there being fewer factor than variables) only if certain algebraic conditions are satisfied, and he further indicates that earlier algebraic studies of this problem are not correct as a result of failure to impose an appropriate condition. Meanwhile various ideas of what is parsimony continue to be reflected in the literature. Ferguson (36) states that although one inclines to think of parsimony in terms of number of factors, one would regard a test with loadings .20, .20, and .82 on three factors as more parsimoniously explained than if it were loaded .50, .50, and .50 on three factors. He thus pleads for a continuous index of parsimony and argues for an index in terms of fourth powers. He points out that this index is maximized by the Quartimax method of Neuhaus & Wrigley (68) which they defend from the point of view that it maximizes the variance of the factor loadings. (These are mathematically equivalent statements.) Neuhaus & Wrigley also give an approximate method of computation which can be used with their method. A method prepared by Carroll (20) is also closely related to Ferguson's principle of parsimony.

Burt finds a logically parsimonious (19) factor analysis to arise in many cases from a correspondence between what he calls the "law of progressive

sign reversal" and a hierarchical factor scheme. Warburton (92) marshalls an array of arguments in favor of taking out as many factors as tests. He also states opposing arguments.

Thurstone's (85) analytic method of arriving at simple structure is reviewed here by title only, having been treated more fully in the 1955 volume of the *Annual Review of Psychology*, on the basis of an earlier version (84).

Lawley & Swanson (57) describe a sampling experiment (using random normal numbers) which was performed to verify experimentally the maximum likelihood method of estimating factor loadings and the  $\chi^2$  test associated with it. Eight samples of 50 observations were constructed; in each case there were seven tests of known construction, with two general factors. In seven cases the  $\chi^2$  test was significant after extraction of one factor and nonsignificant after the extraction of two; in one case the test gave spurious indication that two factors were not sufficient. The authors regard the tabulated results as evidence of substantial sampling error even where samples are moderately large.

Howie (49) reports the results of applying two methods of factor analysis to a series of 36 variables, chiefly cognitive and scholastic. There was much agreement between the analyses yielded by Thurstone's centroid procedure and Burt's group factor method. Each gave eight factors, seven of which could be identified as common to both studies; in addition Burt's method gave (as it must) a general factor explaining .22 of the variance, and Thurstone's procedure gave what appears to be a sex factor explaining .085 of the variance.

A good review of the literature in factor analysis from 1951 to 1954 is given by Solomon & Rosner (77). There is special emphasis on applications in various substantive areas.

## LITERATURE CITED

1. Abelson, R. M., and Bradley, R. A., "A  $2 \times 2$  Factorial with Paired Comparisons," *Biometrics*, **10**, 487-502 (1954)
2. Anderson, T. W., and Darling, D. A., "A Test of Goodness of Fit," *J. Am. Stat. Assoc.*, **49**, 765-69 (1954)
3. Andrews, F. C., "Asymptotic Behavior of Some Rank Tests for Analysis of Variance," *Ann. Math. Stat.*, **25**, 724-36 (1954)
4. Anscombe, F. J., "Fixed-Sample-Size Analysis of Sequential Observations," *Biometrics*, **10**, 89-100 (1954)
5. Bechhofer, R. E., "The Effect of Preliminary Tests of Significance on the Size and Power of Certain Tests of Univariate Linear Hypotheses," (Doctoral thesis, Columbia Univ., New York, N. Y., 1951)
6. Bechhofer, R. E., Dunnett, C. W., and Sobel, M., "A Two Sample Multiple Decision Procedure for Ranking Means of Normal Populations with a Common Unknown Variance," *Biometrika*, **41**, 170-76 (1954)
7. Bechhofer, R. E., and Sobel, M., "A Single Sample Multiple Decision Procedure for Ranking Variances of Normal Populations," *Ann. Math. Stat.*, **25**, 273-89 (1954)
8. Binder, A., "The Choice of Error Term in Analysis of Variance Designs," *Psychometrika*, **20**, 29-50 (1955)
9. Birnbaum, A., "Statistical Methods for Poisson Processes and Exponential Populations," *J. Am. Stat. Assoc.*, **49**, 254-66 (1954)
10. Birnbaum, A., "Combining Independent Tests of Significance," *J. Am. Stat. Assoc.*, **49**, 559-74 (1954)
11. Blum, J. R., and Fattu, N. A., "Nonparametric Methods," *Rev. Educ. Research*, **24**, 467-87 (1954)
12. Box, G. E. P., "Some Theorems on Quadratic Forms Applied in the Study of Analysis of Variance Problems. I. Effect on Inequality of Variance in the One-Way Classification," *Ann. Math. Stat.*, **25**, 290-302 (1954)
13. Box, G. E. P., "Some Theorems of Quadratic Forms Applied in the Study of Analysis of Variance Problems. II. Effects of Inequality of Variance and of Correlation Between Errors in the Two-Way Classification," *Ann. Math. Stat.*, **25**, 484-98 (1954)
14. Bradley, R. A., "Incomplete Block Rank Analysis: On the Appropriateness of the Method of Paired Comparisons," *Biometrics*, **10**, 375-90 (1954)
15. Bross, I., "A Confidence Interval for a Percentage Increase," *Biometrics*, **10**, 245-50 (1954)
16. Bross, I., "Misclassification in  $2 \times 2$  Tables," *Biometrics*, **10**, 478-86 (1954)
17. Bross, I., "Is There an Increased Risk?," *Federation Proc.*, **13**, 815-19 (1954)
18. Burke, C. J., "Further Remarks on One-Tailed Tests," *Psychol. Bull.*, **51**, 587-90 (1954)
19. Burt, C., "The Sign Pattern of Factor-Matrices: A Note on a Problem Raised by Mr. Gabriel," *Brit. J. Stat. Psychol.*, **7**, 15-29 (1954)
20. Carroll, J. B., "An Analytic Solution for Approximating Simple Structure in Factor Analysis," *Psychometrika*, **18**, 23-38 (1953)
21. Chernoff, H., "On the Distribution of the Likelihood Ratio," *Ann. Math. Stat.*, **25**, 573-78 (1954)



22. Chernoff, H., and Lehmann, E., "The Use of Maximum Likelihood Estimates in  $\chi^2$  Tests for Goodness of Fit," *Ann. Math. Stat.*, **25**, 579-86 (1954)
23. Chernoff, H., and Lieberman, G. J., "Use of Normal Probability Paper," *J. Am. Stat. Assoc.*, **49**, 778-85 (1954)
24. Cochran, W. G., "Some Methods for Strengthening the Common  $\chi^2$  Tests," *Biometrics*, **10**, 417-51 (1954)
25. Coombs, C. H., "A Method for Study of Interstimulus Similarity," *Psychometrika*, **19**, 183-94 (1954)
26. Daniels, H. E., "A Distribution-Free Test for Regression Parameters," *Ann. Math. Stat.*, **25**, 499-513 (1954)
27. Darling, D. A., "The Cramer-Smirnov Test in the Parametric Case," *Ann. Math. Stat.*, **26**, 1-20 (1955)
28. Davies, G. P., and Sears, G. W., "Some Makeshift Methods Applied to Complex Experimental Results," *Appl. Statist.*, **4**, 46-73 (1955)
29. Dixon, W. J., "Power under Normality of Several Non-Parametric Tests," *Ann. Math. Stat.*, **25**, 610-14 (1954)
30. Duncan, D. B., "Multiple Range and Multiple F Tests," *Biometrics*, **11**, 1-42 (1955)
31. Dunn, J. E., and Greenhouse, S. W., "Cancer Diagnostic Tests, Principles and Criteria for Development and Evaluation," *Public Health Service Publication No. 9* (U. S. Government Printing Office, Washington, D. C., 23 pp., 1950)
32. Dunnett, C. W., and Sobel, M., "A Bivariate Extension of Student's t-Distribution with Tables for Certain Special Cases," *Biometrika*, **41**, 153-69 (1954)
33. Edwards, W., "The Theory of Decision Making," *Psychol. Bull.*, **51**, 380-417 (1954)
34. Epstein, B., "Tables for the Distribution of the Number of Exceedances," *Ann. Math. Stat.*, **25**, 762-68 (1954)
35. Federer, W. T., and Schlottfeldt, C. S., "The Use of Covariance to Control Gradients in Experiments," *Biometrics*, **10**, 282-90 (1954)
36. Ferguson, G. A., "The Concept of Parsimony in Factor Analysis," *Psychometrika*, **19**, 281-90 (1954)
37. Fiske, D. W., and Jones, L. V., "Sequential Analysis in Psychological Research," *Psychol. Bull.*, **51**, 264-75 (1954)
38. Girshick, M. A., "An Elementary Survey of Statistical Decision Theory," *Rev. Educ. Research*, **24**, 448-66 (1954)
39. Goodman, L. A., and Kruskal, W. H., "Measures of Association for Cross Classifications," *J. Am. Stat. Assoc.*, **49**, 732-64 (1954)
40. Gordon, M. H., Loveland, E. H., and Cureton, E. E., "An Extended Table of Chi-Square for Two Degrees of Freedom, for Use in Combining Probabilities from Independent Samples," *Psychometrika*, **17**, 311-16 (1952)
41. Graybill, F., "Variance Heterogeneity in a Randomized Block Design," *Biometrics*, **10**, 516-20 (1954)
42. Grundy, P. M., Rees, D. H., and Healy, M. J. R., "Decision Between Two Alternatives—How Many Experiments?," *Biometrics*, **10**, 317-23 (1954)
43. Gulliksen, H., "A Least Squares Solution for Successive Intervals Assuming Unequal Standard Deviations," *Psychometrika*, **19**, 117-39 (1954)

44. Guttman, L., "Some Necessary Conditions for Common Factor Analysis," *Psychometrika*, **19**, 149-61 (1954)
45. Halperin, M., Greenhouse, S. W., Cornfield, J., and Zolotar, J., "Tables of Percentage Points for the Studentized Maximum Absolute Deviate in Normal Samples," *J. Am. Stat. Assoc.*, **50**, 185-95 (1955)
46. Hopkins, J. W., "Incomplete Block Rank Analysis: Some Taste Test Results," *Biometrics*, **10**, 391-99 (1954)
47. Hopkins, J. W., "Some Observations on Sensitivity and Repeatability of Triad Taste Difference Tests," *Biometrics*, **10**, 521-30 (1954)
48. Hopkins, J. W., and Gridgeman, N. T., "Comparative Sensitivity of Pair and Triad Flavor Intensity Difference Tests," *Biometrics*, **11**, 63-68 (1955)
49. Howie, D., "A Comparison of Two Methods of Factorizing Test Data," *Brit. J. Stat. Psychol.*, **7**, 31-36 (1954)
50. Jonckheere, A. R., "A Distribution-Free k-Sample Test Against Ordered Alternatives," *Biometrika*, **41**, 133-45 (1954)
51. Jones, L. V., "A Rejoinder on One-Tailed Tests," *Psychol. Bull.*, **51**, 585-86 (1954)
52. Kempthorne, O., *Design and Analysis of Experiments* (John Wiley and Sons, Inc., New York, N. Y., 631 pp., 1952)
53. Kendall, M. G., *Rank Correlation Methods* (Charles Griffin and Co., Ltd., London, England, 160 pp., 1948)
54. Kendall, M. G., "Further Contributions to the Theory of Paired Comparisons," *Biometrics*, **11**, 43-62 (1955)
55. Kimball, A. W., "Short Cut Formulas for the Exact Partition of  $\chi^2$  in Contingency Tables," *Biometrics*, **10**, 452-58 (1954)
56. Lancaster, H. O., "The Combination of Probabilities Arising from Data in Discrete Distributions," *Biometrika*, **36**, 370-82 (1949)
57. Lawley, D. N., and Swanson, Z., "Tests of Significance in a Factor Analysis of Artificial Data," *Brit. J. Stat. Psychol.*, **7**, 75-79 (1954)
58. Lev, J., "The Point Biserial Coefficient of Correlation," *Ann. Math. Stat.*, **20**, 125-26 (1949)
59. Loevinger, J., "The Attenuation Paradox in Test Theory," *Psychol. Bull.*, **51**, 493-504 (1954)
60. Lord, F. M., "Scaling," *Rev. Educ. Research*, **24**, 375-93 (1954)
61. McGill, W. J., "Multivariate Information Transmission," *Psychometrika*, **19**, 97-116 (1954)
62. Malmquist, S., "On Certain Confidence Contours for Distribution Functions," *Ann. Math. Stat.*, **25**, 523-33 (1954)
63. Meehl, P. E., and Rosen, A., "Antecedent Probability and the Efficiency of Psychometric Signs, Patterns, or Cutting Scores," *Psychol. Bull.*, **52**, 194-216 (1955)
64. Mood, A. M., "On the Asymptotic Efficiency of Certain Non-Parametric Two Sample Tests," *Ann. Math. Stat.*, **25**, 514-22 (1954)
65. Moore, P. G., and Tukey, J. W., "Queries," *Biometrics*, **11**, 562-69 (1954)
66. Mosteller, F., and Bush, R. R., "Selected Quantitative Techniques," *Handbook of Social Psychology*, Chap. 8 (Lindzey, G., Ed., Addison-Wesley Publishing Co., Inc., Cambridge, Mass., 2 vols., 1226 pp., 1954)

67. Nelder, J. A., "A Note on Missing Plot Values," *Biometrics*, **10**, 400-1 (1954)
68. Neuhaus, J. O., and Wrigley, C., "The Quartimax Method," *Brit. J. Stat. Psychol.*, **7**, 81-91 (1954)
69. Neyman, J., and Tokarska, B., "Errors of the Second Kind in Testing 'Student's' Hypothesis," *J. Am. Stat. Assoc.*, **31**, 318-26 (1936)
70. Paull, A. E., "On a Preliminary Test for Pooling Mean Squares in the Analysis of Variance," *Ann. Math. Stat.*, **21**, 539-56 (1950)
71. Pearson, E. S., "On Questions Raised by the Combination of Tests Based on Discontinuous Distributions," *Biometrika*, **37**, 383-96 (1950)
72. Perry, N. C., and Michael, W. B., "The Reliability of a Point Biserial Coefficient of Correlation," *Psychometrika*, **19**, 313-25 (1954)
73. Pillai, K. C. S., and Ramachandran, K. V., "Distribution of a Studentized Order Statistic," *Ann. Math. Stat.*, **25**, 565-72 (1954)
74. Rao, C. R., "A General Theory of Discrimination When the Information about Alternative Population Distributions Is Based on Samples," *Ann. Math. Stat.*, **25**, 651-70 (1954)
75. Reiersøl, O., "Tests of Linear Hypotheses Concerning Binomial Experiments," *Skand. Aktuarietidskr.*, **37**, 38-59 (1954)
76. Scheffé, H., "A Method for Judging All Contrasts in the Analysis of Variance," *Biometrika*, **40**, 87-104 (1953)
77. Solomon, H., and Rosner, B., "Factor Analysis," *Rev. Educ. Research*, **24**, 421-38 (1954)
78. Somerville, P. N., "Some Problems of Optimum Sampling," *Biometrika*, **41**, 420-29 (1954)
79. Stein, C., "A Two Sample Test for a Linear Hypothesis Whose Power Is Independent of the Variance," *Ann. Math. Stat.*, **16**, 243-58 (1945)
80. Stoller, D. S., "Univariate Two Population Distribution-Free Discrimination," *J. Am. Stat. Assoc.*, **49**, 770-77 (1954)
81. Stouffer et al., *The American Soldier, I, Adjustment During Army Life* (Princeton University Press, Princeton, N. J., 599 pp., 1949)
82. Tate, R. F., "Correlation Between a Discrete and a Continuous Variable. Point Biserial Correlation," *Ann. Math. Stat.*, **25**, 603-7 (1954)
83. Tatsuoka, M. M., and Tiedeman, D. V., "Discriminant Analysis," *Rev. Educ. Research*, **24**, 402-20 (1954)
84. Thurstone, L. L., "Analytical Method for Simple Structure," *Psychometric Laboratory Report No. 6* (University of North Carolina, Chapel Hill, N. C., 1953)
85. Thurstone, L. L., "An Analytical Method for Simple Structure," *Psychometrika*, **19**, 173-82 (1954)
86. Tsao, C. K., "An Extension of Massey's Distribution of the Maximum Deviation Between Two Sample Cumulative Step Functions," *Ann. Math. Stat.*, **25**, 587-92 (1954)
87. Tukey, J. W., "One Degree of Freedom for Additivity," *Biometrics*, **5**, 232-42 (1949)
88. Tukey, J. W., "Quick and Dirty Methods in Statistics. Part II. Simple Analyses for Standard Designs," *Proc. 5th Ann. Convention, Am. Soc. for Quality Control*, 189-97 (1951)

89. Tukey, J. W., "Unsolved Problems of Experimental Statistics," *J. Am. Stat. Assoc.*, **49**, 706-31 (1954)
90. Tukey, J. W., "Queries," *Biometrics*, **11**, 111-13 (1955)
91. Wallis, W. A., "Compounding Probabilities from Independent Significance Tests," *Econometrica*, **10**, 229-49 (1942)
92. Warburton, F. W., "The Full Factor Analysis," *Brit. J. Stat. Psychol.*, **7**, 101-6 (1954)
93. Wilkinson, B., "A Statistical Consideration in Psychological Research," *Psychol. Bull.*, **48**, 156-57 (1951)
94. Willis, R., "Estimating the Scalability of a Series of Items—An Application of Information Theory," *Psychol. Bull.*, **51**, 511-16 (1954)

# CHILD PSYCHOLOGY<sup>1</sup>

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While it is not too difficult to describe the status of a field of psychological research at a given time, it is much more difficult to venture upon an assessment or evaluation of the state of affairs. Since Barker's (12) review of child psychology for this publication it has become a habit for writers of this chapter of the *Annual Review* to point hopefully to signs that this field of psychological activity is recovering from the doldrums which Barker described.

The reader must decide for himself after reading this chapter whether child psychology is or is not in a healthy state or whether an unambiguous answer can be given to such a question. As a framework for assessing research during the past year, we will try to picture the general outlines and coverage of an adequate theory of child behavior and development. Then we can look at selected examples of research during the past year to see where it contributes to such a theory and what problems it raises.

Granted that it is very dangerous to attempt a description of what a theory of child behavior and development will eventually look like, it is worth while making the attempt and is perhaps not as hopeless a task as it might appear. While no one can anticipate accurately the content of a future theory, it is not impossible to describe some of the questions which a theory must answer and to point to gaps which research must fill if an adequate theory is to be achieved.

## THE STRUCTURE OF THEORY OF CHILD PSYCHOLOGY

Child psychology is a curious hybrid as far as theory building is concerned because it is a part of the general area of comparative psychology on the one hand and a part of the area of developmental psychology on the other. Child psychology is interested in building a theory about the behavior of children. We wish to be able to predict how a child will behave in any specified stimulus situation. Since children behave differently from adults in many of the same situations, an adequate theory of human behavior must contain concepts and parameters which will enable it to encompass the behavior of children. One task of child psychology is to contribute to such a behavior theory by comparing and contrasting the behavior of children and adults, children of different age levels as well as children of different background, racial origin, etc., when they are placed in the same situation. The findings of such comparative studies pose problems for behavior theory, and

<sup>1</sup> The survey of the literature pertaining to this review was completed in May, 1955 but includes no publications after April, 1955.

child psychologists are in a position to contribute to their solution. Thus we must assess research in the field in terms of its contributions to a theory of human behavior, especially to a theory of the behavior of children. This is the role of child psychology as a part of comparative psychology.

As an area in developmental psychology, child psychology is concerned with different phenomena. Here it must make its contribution to a theory of change of behavior. We want to know not only how children behave but also how they become adults. We are interested in situations both as stimuli to behavior and also as antecedent conditions which change a child's personality. We must therefore look at research in child psychology from two points of view, as a contribution to behavior theory and as a contribution to developmental theory.

As far as behavior theory is concerned, it is now commonplace to state that the behavior of a person is a function of the stimulus situation which impinges upon him and also of his own personality characteristics. A boy who trounces his little sister when she teases him about his girl friend behaves the way he does because he is teased and because his affections are exposed to public gaze; yet these stimulus conditions might not have provoked an aggressive response had he been more secure, more inhibited, or wiser in the ways of little sisters. This statement suggests two areas of research, even though both the stimulus conditions and the personality characteristics must eventually be combined into a single theoretical statement.

*Situational factors in evocation of behavior.*—One area of research is concerned with the stimulus conditions of behavior and the various psychological mechanisms which mediate between the stimulus and the response. The frustration-aggression hypothesis is in this area; there are presumably numerous others. In the light of current theoretical writings, we might well subdivide this area and describe separately the stimulus conditions for the instigation of motives, for the evocation of emotional states, for perceiving and cognizing, and for the direction of goal behavior through problem solving, motor behavior, etc. From the point of view of child psychology, we are interested in these stimulus conditions as they apply to children and in the differences between different age levels in the evocation of behavior by a stimulus situation.

*The role of personality traits in behavior.*—A second area for investigation is the role of various personality variables in behavior, particularly the behavior of children. There is considerable arbitrariness as yet about what classes of personality traits should be distinguished, but there seems to be good reason to distinguish between needs, which are especially relevant to the motives of the individual, and abilities, which are especially relevant to the attainment of a goal. Since these classes are obviously not exhaustive, we need a residual category for other personality traits.

*Psychological tests.*—Personality variables are usually investigated by means of psychological tests. Test behavior is of course like all other behavior except that we are not interested in the test behavior per se, but only in what it indicates about the person. We believe that the personality variable re-

vealed in the test is relevant to behavior in the criterion situation where the individual's behavior is important in its own right. But the test behavior can be analyzed as a function of the test situation and the personality traits of the individual, just as is any other behavior. Thus in psychological tests there are two areas of research which can be identified.

*Description of naturalistic situations.*—Thirdly, we must consider how a theory of behavior is used. Since it is a structure which we hope will lead to applications and to the prediction of behavior in important situations, we must have research to build the bridge between the theory and the application. Since naturalistic situations seldom present well-controlled stimulus situations, one step in applying behavior theory is to describe naturalistic situations in psychological terms so that we know what sorts of behavior they evoke and what personality traits are relevant. This step corresponds roughly to a job analysis in industrial psychology. What kind of a situation is a first date or the first day of school?

Turning now to the outlines of a theory of change or development, we see first of all that the change which occurs takes place in the characteristics of the person. Through learning, maturation, or any other kind of change, the person, when placed in a situation, behaves differently from what he did previously in the same situation. There must be change in the personality to account for the changed behavior. The dependent variable in a theory of development is, therefore, the personality variable at the end of the period of change. We can write a functional relationship similar to the one traditionally written for behavior. The characteristics of the person at any time are a function of his characteristics at some previous time and of the environment in which he lived during the interval.

*Psychological ecology: description of the psychological environment.*—The concept of environment used in this statement is not the same as the situation. Nobody remains long in any one situation; his behavior changes the situation or it changes through some external influence. The environment is a term, therefore, to describe the pattern of situations in which the person finds himself. Some children live in an environment in which they are frequently threatened with punishment; others live in an environment in which they are frequently told to do something but suffer no consequences if they fail to obey. Nobody is constantly under threat of punishment, but it is a much more probable situation in some children's environments than in others. Not only may the probability of various situations differ from one environment to another, but the sequences of situations may also differ. In some environments punishment inevitably follows disobedience; in others it seldom does. So we might think of an environment in terms of the probabilities of the occurrence of various situations and the probabilities of various outcomes once a change is initiated.

There are many problems to be solved in describing environments; these are the problems to be met in psychological ecology. Thus psychological ecology is one area of research in developmental psychology. In view of the



very great importance given to learning theory in modern theories of development, it becomes crucial to have accurate descriptions of the patterns of frustrations, reinforcements, and associated stimuli which mark a child's environment. It is surprising, therefore, that ecological research is not more popular.

*Relation of personality traits at two different times: personality consistency and maturation.*—In addition to describing the environment, there are two obvious areas of research in developmental psychology. One is the study of the relationship between the person's characteristics at two different times, if the environment is held constant. These are the problems of consistency of traits, and their lawful change through maturational processes.

*Relation of personality characteristics to the environment in which the person has been living.*—In the other area of developmental research we study the relation between the personality variable and the properties of the environment in which the person has been living. For such studies the personality traits at the time of entrance into the environment are either held constant or are randomized. Defined broadly, this area of research includes the entire field of learning, but even aside from studies of learning, it receives a great deal of attention in modern psychological research.

#### GENERAL REMARKS

This outline of areas in which theory building and research might take place is to some degree arbitrary. More or fewer subdivisions could be described. This account has tended to describe the areas in terms of relationships between single variables rather than in terms of more complex designs. A research could, for example, investigate both the beginning personality traits and the properties of the environment and their joint effects upon later personality.

Regardless of these arbitrary matters, the essential structure of this framework for a theory seems reasonable. If this general structure is accepted, it has some implications for the strategy of research. A strong case, for example, can be made for the proposition that a theory of behavior is logically prior to a theory of development. Until we know what personality variables are valuable for predicting behavior, we hardly know how to define a fruitful developmental problem. Similarly there is a certain sense in arguing that the study of situational factors in behavior is logically prior to studying personality variables, because the behavior which defines a personality variable reflects the stimulus situation.

To review briefly, we have defined seven areas of research which can be integrated into a more or less complete theory once each of the areas has been filled in. Four of these areas are concerned with the theory of action or behavior; three are concerned with a theory of development.

#### DISTRIBUTION OF STUDIES

It is interesting, first of all, to see how much research effort is going into each of these areas. The bibliography of this chapter is a list of all of the pub-

lications in child psychology during the past year which report empirical data rather than opinion only. In addition, and this is where the decisions are difficult, it includes some publications which are strictly attempts at theory building without any empirical data. We have not included, however, the myriad publications which are didactic articles, usually directed at the lay public, or the many articles describing administrative problems in child welfare, or clinical management, or surveys of such problems in various geographical regions. We have probably excluded some "didactic" articles which others would argue were theoretical contributions and have probably included some which others would have excluded.

Taking the bibliography at its face value, we have tried to assign each article to one or more of the areas listed in the previous discussion (see Table I). The emphasis of current research is quite clear. Almost half of the studies are directed toward the elucidation of the relationship between personality variables and environmental conditions. Relatively few studies explicitly attack the situational factors in behavior or the behavioral manifestations of personality variables in children. Such relationships do, of course, come up as by-products of some other studies. Relatively few studies are primarily concerned with the analysis and validation of psychological tests of children, although many psychological tests are employed in the studies of the relationship of personality to environment.

#### RELATIONSHIPS BETWEEN "DISTANT" VARIABLES

In trying to categorize studies into these classes, it became obvious that a great many of the researches, particularly those studying the relation of personality to environment, investigate the relationship between variables which are convenient to employ but which are connected by a long complex chain of intervening variables. Here we use the term "intervening variables," not in the sense of an unobservable hypothetical concept but rather as explicitly observable variables which happen not to be observed in the particular study. In other words, the relationships which are uncovered by the investigation frequently pose a problem but do not answer one. This statement is not made as a criticism; exploratory research should pick easily observable variables and should frequently be concerned with the relationships which have an obvious practical implication. Once such relationships have been uncovered, however, the maximum contribution of such findings depends upon a thorough study of the intervening variables. Child psychology seems to lack studies of this second kind.

#### EFFECTS OF DEPRIVATION OF MATERNAL LOVING CARE ON PERSONALITY DEVELOPMENT

The failure to follow up promising leads can be well illustrated by the many studies on the effect of institutionalization upon personality development. The first publications on this topic came in the late thirties. By now we can be reasonably sure that something about institutionalization generally has a deleterious effect upon personality development. We have seen

TABLE I  
REFERENCES CLASSIFIED ACCORDING TO RESEARCH AREAS

1. Situational factors in the behavior of children (1, 5, 6, 39, 59, 85, 90, 98, 100)
2. Personality variables in the behavior of children:
  - a. Age differences (5, 29, 31, 35, 41, 50, 51, 54, 71, 83, 85, 89, 90, 108, 114)
  - b. Sex differences (3, 10, 27, 35, 50, 65, 66)
  - c. Relation of physical characteristics and personality (111, 117)
  - d. Relation of personality variables to behavior (4, 43, 46, 77, 84, 88, 93, 105)
3. Psychological tests:
  - a. Situational aspects of test behavior (23, 30, 63)
  - b. Personality variables in test behavior (4, 19, 28, 35, 47, 114, 119)
4. Description of naturalistic situations
5. Description of environments (20, 26, 36, 37, 38, 41, 55, 68, 69, 91, 92, 96, 102, 110)
6. Relation of personality variables at different times:
  - a. Consistency of personality (56, 62, 82)
  - b. Maturation (44)
  - c. Longitudinal studies (2, 53, 56, 62, 81, 87, 113)
7. Relation of personality to environment:
  - a. Animal studies of effect of early environment (61, 67, 72)
  - b.

	<i>Socio- economic status</i>	<i>Family relations</i>	<i>Other environments</i>
Needs and attitudes	(22, 73)	(10, 18, 24, 25, 27, 41, 49, 64, 66) (70, 71, 78, 86, 94, 103, 106)	(7, 43, 50, 57) (33, 60, 99, 115)
Abilities	(47)	(65, 74)	(42, 118)
Adjustment		(15, 51, 52, 58, 71, 79, 92, 101, 106, 107)	(8, 40, 109)
Other personality variables	(48, 116)	(21, 104, 106, 111)	(45, 116)

various articles "debunking" research on the effect of childhood experience upon personality, but as Stone (107) points out, these critiques too frequently throw out the baby with the bath.

Here then is a research area which surely contains pay dirt. Even those articles in the past year which go counter to the general trend do not dismiss the issue. They merely point to problems. Caplan (33) reporting upon institutionalized rearing of children in certain communities in Israel points to the fact that the adults who have been raised in this way do not seem seriously disturbed as we would expect from other studies of institutionalization. Lewis (70) also points to cases of institutionalized children who do not show the serious damage we might expect.

We have, therefore, an interesting and reasonably well-confirmed relationship to work with, but in the 15 years of work on this topic, we are still quite uncertain about what it is in institutionalization that has the effects, and we are not even sure just what the effects are except that they are bad. In some cases they seem to be a craving for love; in others, an inability to love. The effect has been attributed to impersonal treatment, deprivation of love, and inconsistency of treatment.

There is clearly a crying need for some detailed research on this problem. One important line of effort is the comparison of the environments of institutionalized children with home environments. If we knew how often an environment challenged, gratified, or frustrated a child; if we knew how often it reinforced his approaches to people; if we knew how much it stimulated or failed to stimulate a positive action from the child, we would be in a better position than we are to understand its effects.

These are all ecological problems and are essential steps in understanding the impact of an institutional environment upon a child. If we had such ecological studies, we would probably find that institutions differ in the kind of environment they provide; surely we would expect that the institutional environment of children in Israel would differ from the institutional environment in orphanages in the United States. The diversity of outcomes in the two types of institutional environments is an opportunity to learn more about the laws of development, but only if some child psychologists are willing to make detailed studies of the process by which institutions affect the behavior and development of children.

The same emphasis upon establishing relationships between variables without studying the mechanism relating the two can be seen in other areas of research in the past year, and because of that we do not learn as much about the theory of child behavior and development as we might.

If we look at the 16 studies relating needs or attitudes to various aspects of the child's family environment (see p. 264), at least 10 of them are concerned with relationships which skip several observable intervening variables. Of the three empirical studies relating adjustment to the child's relation with his family, all skip important intervening variables. The author of one of them [Behrens (15)] in fact would probably disagree with the position being maintained. She is apparently pleased with her finding that the correlation between child adjustment and the mother's character is higher than the correlation with the mother's child rearing practices. Such a finding is not uncommon, but it is certainly dangerous to read into it that the mother's personality influences the child in some mysterious way unrelated to her behavior.

In some ways the widespread use of personality tests in child psychology reflects the same tendency. There are many tests in use which relate the child's behavior in the test situation to his personality as revealed in other situations, with little or no attention to the explanation of the test behavior. There is certainly no adequate theory to explain how ink blots elicit re-

sponses, although research workers on the Rorschach have become more and more sensitive in recent years to the importance of the test situation. Similarly we have but little theory about the process by which a picture elicits a story; we correlate the story directly with the personality characteristics.

In the more careful studies using tests, the stimulus condition is held as constant as possible so that variation in behavior is presumably attributable to personality factors. Furthermore, some of the more commonly uncontrolled aspects of the test situation are studied, e.g., to see if equivalent behavior is obtained with different experimenters. If such conditions are carefully maintained whenever the test is used, then the comparability of the results with the results of the standardization group is maintained. This is an important step.

But in terms of using the test results for research purposes and capitalizing upon their potential contribution to theory construction, we need to devote much more time to the analysis of the test behavior. If we understood how test behavior was elicited, we could design tests rationally rather than intuitively or by chance. We would not need to describe a projective test stimulus as ambiguous and prize it for its obscurity. Instead we could know on theoretical grounds what kinds of responses it is likely to evoke, and we could design effective new stimuli for particular purposes.

#### STUDIES OF TEST BEHAVIOR OF CHILDREN

If we look at the studies in the past year of psychological tests of children, we can see illustrative examples as well as some efforts to understand the test situation more fully. There are, for example, two studies on the art work of children sometimes used for personality diagnosis. Stewart (105) has made an extensive analysis of the drawings and paintings of children's self-portraits. He has measured such paintings in terms of 31 detailed variables, like heaviness of line, etc. By means of cluster analysis he has picked out groups of variables which are highly correlated and which can be used to obtain leads to the behavior of the children. In another study of painting, Corcoran (39) points to one factor which must be controlled before the child's selection of color can be used as an actual color preference. He finds a tendency for the child to use the end colors of whatever set is available, regardless of what particular colors there are.

Sigel (98), studying the child's behavior in a sorting test, is specifically concerned with the stimulus presentation of the objects to be sorted. He compares the categorization of objects, if they are presented as words, pictures, or actual objects to be looked at, or as objects which the child is allowed to handle; he finds that the stimulus presentation is irrelevant for the child's sorting behavior.

Biehler (19) studies the agreement between sociometric choices of children and the actual behavioral choices of companions in the play groups. At the kindergarten level, he finds that the two choices are the same, at

least as far as the child's first choice is concerned. For second and third choices there may be considerable discrepancy.

Two other studies are in a sense validity studies of tests. Broida & Thompson (28) study the relationship between signs of "insecurity" in the child's Rorschach responses and his reaction to a stress situation and find a significant relationship. Amen & Renison (4) relate anxiety scores from a test previously standardized by Temple & Amen (112) to the characteristics of children's play. The play characteristics they observe are constructiveness, fantasy, and mere manipulation of play material. There is a high correlation between the amount of constructive play, the amount of anxiety, and IQ. There is no relation between the amount of fantasy play and anxiety.

In summary, then, we have seen how many of the studies during the past year have related variables without investigating the intervening variables even when these are observable. Furthermore, many studies use test behavior as a personality index without analysis of the relation of the test situation to the behavior. The only danger in these procedures is that the findings may be left in that state of affairs. Until the mediating process is understood, the results of such studies remain a problem and they do not contribute what they might to a theory of behavior or development. Looking at the pattern of studies, there is some reason to suspect that research in child psychology has not been directed sufficiently to the study of the mediation processes.

#### RELATION OF FAMILY RELATIONS TO CHILD PERSONALITY

Within this general topic there are two general classes of studies, one describing the family, the other relating the behavior of the child to family variables. Turning to the first of these, we must begin with a statement that the boundary line between descriptions of the child's family environment and general studies of the family as a unit is arbitrary. We have by no means reported all of the studies in family sociology.

The problem of describing the child-rearing practices of a family is a complex one; it is difficult to know just what behavior patterns to classify together. If the child-rearing practice is described in terms of the parent's behavior or intention, then we obtain a categorization of practices related to the personality, attitudes, and beliefs of the parent. If the child-rearing practice is described in terms of its impact upon the child or what it communicates to the child about the parent, then different sets of behavior patterns will be classified together. Only if we assume that the parent's behavior consistently has the effects it is intended to have and is an accurate communication, do the two bases of classification agree. Sometimes we look at the impact of a behavior pattern on the child and then assume that it must have been what the mother intended, if not consciously then unconsciously.

So far as this author knows, nobody has developed a clean-cut solution to this dilemma. Most analyses of parent behavior and parent-child relations

are thoroughly muddled in this respect. Just to illustrate, the Champney (34) scales used at the Fels Research Institute were intended to describe the impact of parent behavior upon the child, but the theoretical analysis of them made by Baldwin, Kalhorn & Breese (11) are clearly analyses of parent motivation and personality more than analyses of the psychological environment of the child.

The studies on family environment and parent behavior in the last year show the same mixture. One of the more elaborate attempts to describe child-training practices is by Sewell, Mussen & Harris (96). They factor analyzed 38 specific child-training practices. The resulting factors are not strange, but they do not agree very closely with previous factor analyses of parent behavior. There are two permissiveness factors, one with respect to early feeding, a second with respect to toilet training. There is a third factor, noninsistence, which is distinguishable from permissiveness, and still a fourth, casual treatment. This makes a finely differentiated description of the general area of permissiveness. On the other hand, the area of acceptance-rejection is not explicitly represented by any factor; two factors, parent-child interaction and nonpunitive treatment, are related to it. Finally, promotion of independence is a separate factor. It seems likely that this whole analysis is more focused upon the behavioral consequences of the practice than upon the parental motivation and is thus an improvement over some previous analyses from the point of view of describing the child's environment.

Another interesting study of the child's environment is by Langford & Alm (68). They are concerned with the accuracy with which different parents can predict the child's responses on the California Test of Personality. They find quite consistent results within the group they study; the best predictions are by fathers for sons, next by mothers for sons, thirdly by mothers for daughters, and the least accurate predictions are by fathers for daughters. It would seem that sons are more easily predictable than daughters, and that the like-sex parent does better than the unlike-sex parent. We know some of the factors contributing to such accuracy scores; similarity of the estimator and the person estimated is one important factor. This may be behind the like-sex scores, an interpretation suggested by the findings reported by Brodbeck (27) that at age 10, girls are more like their mothers, while boys are more like their fathers. Still Brodbeck found that by age 14 this like-sex similarity had largely disappeared; the children in the Langford & Alm study were 12.

The implications of accuracy scores for parent-child relationships have not been spelled out. We would certainly presume that accuracy of prediction of a child's behavior would make the parent more effective in his relations with his child, but there are too many other factors for it to be safe to make such an assumption.

Turning now to some studies of the consequence of family relations upon the behavior of the child, we find a cluster of studies which branch out from



the traditional study of parent-child relations to the study of the child's position in the family. Such an extension of the scope of the antecedent variables is an important step; it is inconceivable that such things as sibling relations and the role of the child in the family are not important factors in personality development.

We can begin with the study by Bossard & Ball (24) on personality roles in the large family. These authors approach the topic with the methods of anthropology and inquire about the various roles in the family from informants in 64 families. Like many ethnographies, the study may give the impression that there is more uniformity among families than there is; yet it is a significant exploratory study. Bossard & Ball describe eight roles and can say something about the ordinal position of the child who is likely to adopt some one of them. First is the role of the responsible child; the person in this role takes life seriously and may be somewhat bossy in his relations to other siblings. He is often the first child, especially if a boy. A second role is that of the sociable, well-liked child; this is often taken by the second child. Then a third role, not necessarily taken by the third child, is that of social butterfly; here is the child who puts a high value upon social activities *per se*. The fourth is that of the studious child. The fifth is of the isolate, the one who minds his own business and does not interact much with his siblings. The sixth is that of the irresponsible child, the one who shirks responsibility. The seventh is the role of the sickly child, the sibling who is not well. Last is the role of the spoiled child; he is often the youngest child in the family.

It is obvious that not every family can have children to fill all these roles; on the other hand these are not considered by Bossard & Ball to be merely a classification of the kinds of children. If there is a large family of six or eight children, there is a certain pressure for different children to take different roles so that many of these roles will be found in a single family. It is a fascinating study and immediately raises the question of how this role-taking occurs. The study of the family as a social group and the application of the methods of the small group to the family is a promising area of research and one which might help us answer the questions raised by this study.

Lasko (69) has investigated a small portion of this problem, the difference in the parental treatment of first and second children. One of the factors which led her into such a study was the frequent report by mothers that the second child was so much more sociable and outgoing than the first. She found several differences between the ratings of parents of first children and second children; probably the most important is the greater amount of attention given to first children.

These findings of Lasko are used for part of the interpretation in an important study by Koch (65, 66) who is concerned with the relation between family constellation and the personality of children. One study reports upon abilities, the other upon certain of the child's attitudes toward adults. These are the dependent variables. The various aspects of family constellation

which are reported are (a) sex of child, (b) whether he is first-born or second-born (all the children in the study are one or the other), (c) sex of the sibling (all of the children in the study have a sibling), and (d) the age difference between the child and his sibling (less than 2 years, 2 to 4 years, or 4 to 6 years). She has 24 matched groups representing all of the possible patterns of these variables and 16 children in each group.

The results are quite complex and by no means easy to summarize. In the study of primary mental abilities, for example, we find that for verbal ability, boys have higher scores than girls, if we compare only first-born children whose siblings are less than two years younger. In general, children with male siblings obtain higher scores than those with female siblings. On perceptual speed, on the other hand, first-borns are consistently worse than second-born children. In terms of total score and general trends, second-born children are higher than first-borns, and children with male siblings do better than children with female siblings.

When we look at attitudes as well, we again find that the presence of a male sibling, especially if the child herself is a girl, is a potent factor. Koch wonders if such a pattern does not present the girl with a severe challenge and force her to vie for the attention and concern of her parents. Thus her attitudes become more adult-oriented.

These are important beginning studies in an area. Clearly what we need, here as elsewhere, are more studies to spell out the relationships. By observing first-born girls with younger male siblings, we could obtain evidence to test the hypotheses Koch suggests. To come to a clear understanding of these relationships, we need to know how the psychological environments of children in different positions in the family differ.

Harris *et al.* (49, 50) at the University of Minnesota are interested in the development of sense of responsibility. They have developed two measures, a citizenship scale and a check list for teachers to use in evaluating their students. They have found that in terms of these measures, girls are more responsible than boys, that responsibility increases with age, and that urban children obtain higher scores than rural. Of these three, the age trend is not very marked and the other two differences are significant even if age is held constant. They are also concerned with family factors as antecedents for responsibility. Particularly it seems that children who carry responsibility in the home should be ones who would score high. Perhaps children who actually carry responsibility at home are responsible, but the mere assignment of home chores is only slightly related to these test scores.

Turning now to studies in the more traditional pattern which investigate psychoanalytic hypotheses by studying the relation between child-rearing practices and selected aspects of child behavior, we find an extensive study by Bernstein (18). He is primarily concerned with two antecedent variables, amount of sucking reinforcement during infancy, and age and method of bowel training. As consequent variables, he studies constipation, response to weaning, propensity to collect things, choice of a suckable food (lollipop)

rather than a piece of chocolate, and the subject's response to certain requests designed to measure separation anxiety and negativism. Bernstein's findings support the hypothesis that reinforcement increases the sucking drive and makes for more resistance to weaning. Weaning may be correlated with thumbsucking; but sucking deprivation is not correlated with thumbsucking in this study. Sucking reinforcement is significantly related to the choice of a lollipop.

The cluster of consequent variables which were expected to be related to toilet training are instead related to sucking reinforcement. Furthermore, they are not correlated with each other. Constipation is positively related to sucking reinforcement, but collecting is negatively related to the same antecedent variable; thus constipation and collecting are unrelated. Coercive toilet training is related to separation anxiety, negativism, and immaturity.

By now we are beginning to be clear about the consequences of age of weaning on resistance to weaning, at least for our culture where the child is almost always weaned before he is two years old. The relation to thumb-sucking seems to go in the same direction but less strikingly. The conditions under which deprivation leads to intensification of drives are, however, not clearly understood.

Two very interesting theoretical articles have appeared on this general problem. Spitz (101) is concerned with the mechanism by which deprivation leads to its various consequences. He does not hypothesize about the empirical conditions which result in deprivation rather than mere lack of reinforcement, but he does relate the whole problem of deprivation to Selye's general adaptation syndrome. Selye has shown for many different sorts of stresses how there is an initial period of upset, then an adaptation to the stress. Then if the stress is too strong for the adaptation to be permanent, there is a final loss of adaptation and, eventually, death. This course of events, involving as it does opposite overt reactions to the same stress, may make a fruitful parallel for research upon the contradictory effects of infant deprivation. Mittelman (80) in a different sort of article gives an excellent discussion of activity as a drive. He reviews the literature and proposes some hypotheses about the psychodynamic aspects of muscular activity.

A study by Stendler (103) on possible causes of overdependency suggests a number of alternative antecedents. She finds no evidence that infant disciplines have any such effect, which does not confirm earlier findings, but she finds a relation between some cases of overdependence and overprotection. Not all cases show overprotection, however, and she finds that in these other cases the condition might be attributed to serious discontinuities in socialization or to absence or weakness of the father.

A study by Ausubel *et al.* (10) is concerned with ego-development, an area to which Ausubel has contributed a great deal (9). His theoretical formulations lead to the prediction that children who are approved or valued extrinsically, i.e., because of what they do or achieve, are more likely to have

feelings of omnipotence, to be more tolerant of goal frustration, and to be less mature. (This seems very similar to conditional love.) He used an interesting measure of omnipotence, a sort of maximum level of aspiration test. He asks the child which one of a list of things he "could" do. His hypothesis is confirmed. He finds, incidentally, that school-age girls feel more intrinsically valued than boys.

Before leaving the topic of the effect of family relations upon personality development, we should mention two reports which describe research projects rather than results. Escalona (41) and Klatskin & Jackson (64) all are connected with very important research-projects on the relation of the infant's environment to various aspects of his behavior, personality, and development. We may look forward to reports on the results at a later date.

In addition to these two methodological reports, a symposium entitled "Learning Theory and Identification" was published during the year (27, 78, 94, 95). There is considerable agreement among the members of the symposium in their attempts to account for the phenomena described in psychoanalytic theory as identification. Identification is here concerned with learning to imitate and through imitation to acquire the values held by others. Seward (95) analyzes the conditions under which reward and approval for "correct" behavior will lead to identification and when punishment for "incorrect" behavior will do the same thing. The result of the analysis is the prediction that the kind of identification fostered by punishment will be limited more closely to the acts which are punished, while reward and approval will tend to generalize more to actions which are quite unlike those specifically reinforced. In psychoanalytic theory we find the concept of "identification with the aggressor." Seward feels that such identification can occur but that it will be less effective in transmission of parental values than identification with the loving one. Martin (78) contrasts psychoanalytic theory of identification with formulation in terms of reinforcement and feels that the second is a simpler explanation of the phenomena. Brodbeck's discussion was referred to earlier in connection with the similarity of children and their parents.

In all of these treatments, there is little effort to see if the psychoanalytic theory of identification involves other phenomena than imitation, and congruence of behavior and values of the child and the person with whom he identifies. There are other phenomena related to the general concept of identification which could well be discussed. For example, when the child reacts to an insult of the parent as if the child himself were insulted, he is not merely accepting the parental values, he is putting a special value on the parent. By reducing identification merely to those phenomena which are required in socialization, learning theorists may lose some of the meaning of identification. On the other hand, they are primarily concerned with socialization and as long as they can account for the transmission of parental values to the child, they may feel that it is unimportant whether they capture all of the other connotations of the term "Identification." Regardless of these minor

differences in opinion, this symposium only illustrates again the importance to the field of child psychology of the work in learning and behavior theory.

#### SOCIOECONOMIC STATUS

After studies of the family and its influence on child development, studies of social class are perhaps as common as any other. Of course, many of the effects of social class on child behavior and development are presumably mediated through the different child-rearing practices in different social classes. There are several studies of these differences under way at the present time, but we will have to wait a year to find out about them.

During the past year one of the important research studies has been an investigation comparing a standard intelligence test and a revision of the test to make the content more suitable for children of lower as well as middle social status [Haggard (47)]. The experiment was also designed to study the effect of practice and motivation upon the two varieties of intelligence tests. First the standard test was given. Then to various subgroups of subjects, practice for three days was given. For certain of these subgroups the practice was motivated by an offer of a free pass for those who did well. In other subgroups the performance on a repeat test was motivated. There were two sorts of repeat tests, the standard one and the test revised to be more suitable for lower status children. And, of course, the entire experiment included groups from two socioeconomic levels.

The results indicate that the revised test showed greater improvement than the standard test for both socioeconomic levels, but it had a greater effect on the lower social status group. Motivated practice interfered with gains for both social groups and on both retests. A motivated retest, however, brought improved performance but only on the standard test. This might be taken to indicate that the revision of the items makes the test less susceptible to motivation. Similarly practice did not significantly increase the gains on the revised test despite the fact that the practice was on items of the revised type. It did help the lower social group more than the middle; the reverse was true on the standard retest. Finally Haggard found that when a revised initial test was given, both social status groups obtained higher scores than on the standard test and that the differences attributable to social class were reduced. These differences could be still further reduced if the test items were read orally to the subjects rather than read by the subjects. There is still a social class difference in scores, however, which Haggard and other workers like Davis and Eels believe are artifacts.

Another difference between the middle and lower class which has been found by some studies is a greater amount of aggression in the lower class. There are two studies relevant to this problem, one by Maas (73) on the behavior of adolescent club members toward their club officers and adult club leaders and the other by Body (22) on the differences between two nursery schools, one a university school, the other a day care center catering more to lower socioeconomic levels. Neither of these studies came out in the

predicted way. Body found that there was much more aggressive behavior in the university school than in the other. Maas expected that the lower class members would be more aggressive, less collaborative, and more digressive; instead their behavior toward adult and peer group leaders did not show all of these characteristics. Only toward peer group leaders were they aggressive. Even then they were not more digressive.

#### LONGITUDINAL STUDIES

The past year has seen several publications on the problems of longitudinal research and contributions to its methodology (17, 56, 62, 81, 113) as well as the publication of some records of repeated observation or testing on the same child (2, 53, 87).

First is the accelerated longitudinal approach of Bell (17). He proposed this technique earlier (16) and presents in this study an example of it. He uses Shuttleworth's (97) data to compare his and Shuttleworth's methods. The accelerated longitudinal method consists of studying a number of groups of children of different ages for several years each instead of a single group for a long-enough period to cover the entire age range. By choosing these groups so that the curves of different groups overlap; i.e., so that the beginning year for one group overlaps with the last year's observations on the next younger group, the data approximate what would be obtained from a single longitudinal group. Bell shows the comparison. If one is interested only in average growth-curves, then the cross-sectional method rather than any longitudinal method may be used. But the longitudinal method is the only one for obtaining continuous individual growth-curves, and it is just this feature which has made the longitudinal study so attractive in the past. Bell tries to meet this problem by matching individuals in successive groups in terms of the overlapping curve. If Group A were measured from age six to eight, and group B from age seven to nine, then Bell would try to match individuals in groups A and B in terms of the curve from seven to eight. If he obtained a good match, then he would assume that both children in each matched pair, if measured from six to nine, would show the same curve. This curve is estimated by one child's curve from six to seven, and by the other child's curve from eight to nine. It is a sort of extrapolation of each curve with the data from a matched case. The Shuttleworth data are very good in some ways for testing this approach, because there are some marked individual differences in the slope of the curve at the early period, as well as groups whose curves are not too different at the beginning even though they become quite different later. It is this last type of curve which is the most difficult for the accelerated method to estimate accurately.

A second methodological approach to the analysis of longitudinal data, that by Hofstaetter (56), is extremely interesting. Hofstaetter uses Bayley's data (13, 14) on the correlation between intelligence test scores at different age-levels. He factors the entire matrix of intercorrelations and finds three clear factors. The items in the battery are age levels so the loadings on each



factor can be plotted as an age curve. The first factor has its peak loadings in the early years and corresponds reasonably well to the period when sensori-motor items make up an important portion of the test. Bayley has already speculated on this factor. A second factor reaches its peak at about three and corresponds, Hofstaetter feels, to the period of negativism. This becomes an important factor in test performance at that age. The third factor presumably represents intellectual ability and reaches its high loadings after the age of five or six. This analysis provides us with an improved picture of the correlation between successive age levels and the customary view which says that the correlation decreases with the time between the two tests and that successive correlations are higher for older children than for younger ones.

Two other articles on the analysis of longitudinal data, by Kerlinger (62) and Tyler (113), treat successive measurements on the same individual as a series of scores and apply the usual methods of correlation and variance analysis to them. In Tyler's case the scores are growth increments rather than actual measurements. Kerlinger's analysis of variance is based on "growth ages" of various variables. He tests the significance of the variance between variables to pick out a heterogeneous grower. The problem which is still unresolved in all these treatments of longitudinal data is the statistical dependence among the measures at different age levels. All of us who have tried to analyze longitudinal data in this way would do well to consider the problems the economists have uncovered in their studies of the relations among time series.

#### DEVELOPMENTAL STUDIES

Studies of the development of some ability or some behavior pattern through comparison of a number of age levels are not as common as they once were. There were four such studies during the past year. Ames & Learned (5, 6) have studied the responses of children to the kaleidoblocks. This is a set of different shaped blocks designed to permit a wide variety of constructions. By now we are all familiar with the careful behavioral analyses characteristic of these authors, and we find them again in these two studies. Ames & Learned make a detailed analysis of the use of different blocks, the approach to the problem, the completed construction, etc.

Strauss (108) is concerned with the development of the child's conception of rules, in this case, rules governing financial transactions. By asking children many questions about buying, selling, prices, etc., and applying scale analysis to the results, Strauss is able to describe seven stages in the development of understanding of rules. The stages have a familiar Piaget-like flavor and describe such things as the acceptance of the rule as given; the ability to verbalize the principle; and finally toward the end of the development, the ability to understand breaking the rule deliberately for personal motives. In a different area MacRae (76) repeated some of Piaget's experiments on moral development. He finds that no single continuum can



account for the differences in behavior; three are required. Furthermore he finds no relation of these to parental authority. Another study shows developmental trends in symbolic behavior [Hodges (54)]. Hodges obtained age differences in the child's ability to solve the double alternation problem which has been so often used to study symbolic behavior in animals. Pratt, Hartmann & Mead (90) report a study on the meaning children of different ages assign to indeterminate number-concepts like "few," "several," and the like. In general, older children agree more with each other on the size of such concepts, and they also estimate the number as smaller. For young children, for example, "few" means seven or eight objects, while for older children it is four or five.

One final study in this area is not exactly a developmental study because it is concerned with only one age level, but it belongs in the same tradition. Tyler (114) has investigated the organization of likes and dislikes of 10-year-olds as one part of a study of the development of vocational interests. She finds that the data can be best organized around dislikes. Boys, for example, show three sorts of dislikes as revealed in a factor analysis: a rejection of inappropriate activities, an anti-sissy factor, and an anti-work factor. Girls show an anti-activity factor, an anti-aggression factor, and a rejection of inappropriate activities.

#### EXPERIMENTAL STUDIES OF CHILDREN

Children have frequently been studied in order merely to obtain specific information about children. There are other reasons, however, for studying children. The first is that children may be good experimental subjects for investigating certain sorts of relationships in behavior theory. Just as rats have certain advantages for studying some sorts of behavior, children may have other advantages. A second reason for using children as subjects for many of the traditional learning experiments is that the differences which are revealed may bring about a broadening of the theory. Spiker and his colleagues at Iowa are actively using children as experimental subjects for the investigation of various problems in behavior theory. Two studies [Cantor & Spiker (32); Spiker & Terrell (100)] have come out this past year. The first is concerned with nonreinforced trials in learning. Spence has proposed the hypothesis that nonreinforcement of incorrect choices as well as reinforcement of correct choices lead to learning. This has been confirmed in rats; in the Cantor & Spiker study the same hypothesis is confirmed for preschool children.

Spiker & Terrell studies the effect of names upon transposition behavior. Spence long ago formulated a theory of transposition behavior in rats which did not depend upon any relational learning. In humans, behavior theorists have frequently argued that verbal responses might serve as another mechanism for transposition of learning from one situation to another. In this study the subjects were divided into several subgroups who learned to respond to the middle of three-sized stimuli but who differed in the degree to which a label "dag" was assigned to the correct stimulus. The various

controls are complex and the results not entirely clean-cut, but in general we can say that assignment of a label does increase the probability of the child's transposing his learning to a new situation.

#### HISTORY OF CHILD PSYCHOLOGY

Before concluding it would be well to mention one further study by McLean (75) who has been in the office of the Division of Psychology and Anthropology of the National Research Council for many years. She has written a history of the activities of the Committee on Child Development. This committee was instrumental in organizing the Society for Research in Child Development and the various publications in Child Development sponsored by that organization.

#### SUMMARY

To summarize, research in the field of child psychology has been rather scattered this past year. Most of the effort has gone into investigations of the influence of environmental factors upon development, largely development of personality. Of this group the most frequently studied antecedent variable is the parent-child relationship, although other aspects of family life as well as the wider social environment have received some attention. A relatively small amount of effort has gone into the study of child behavior per se, particularly into the investigation of those child behavior variables which mediate the over-arching relations between childhood experience or family environment and personality development. If this summary has any moral it lies in this last fact. Child psychology should not only devote itself to the exploration of the big problems of personality development and socialization, but should also take time to exploit these studies and learn what they can tell us about a theory of child behavior and development.

#### LITERATURE CITED

1. Albino, R. C., "Defences Against Aggression in the Play of Young Children," *Brit. J. Psychol.*, **27**, 61-71 (1954)
2. Allen, R. M., "Nine Quarterly Rorschach Records of a Young Girl," *Child Development*, **26**, 63-70 (1955)
3. Amatona, Sister Mary, "Contrasts in Boys' and Girls' Judgments in Personality," *Child Development*, **25**, 51-62 (1954)
4. Amen, E. W., and Renison, N., "A Study of the Relationship between Play Patterns and Anxiety in Young Children," *Genet. Psychol. Monographs*, **50**, 3-41 (1954)
5. Ames, L. B., and Learned, J., "Developmental Trends in Child Kaleidoblock Responses," *J. Genet. Psychol.*, **84**, 237-70 (1954)
6. Ames, L. B., and Learned, J., "Individual Differences in Child Kaleidoblock responses," *J. Genet. Psychol.*, **85**, 3-38 (1954)
7. Anderson, H. H., and Anderson, G. L., "Children's Perceptions of Social Conflict Situations: A Study of Adolescent Children in Germany," *Am J. Orthopsychiat.*, **24**, 246-57 (1954)
8. Atcheson, J. D., and Williams, D. C., "A Study of Juvenile Sex Offenders," *Am. J. Psychiat.*, **111**, 366-70 (1954)

9. Ausubel, D. P., *Ego Development and the Personality Disorders* (Grune & Stratton, Inc., New York, N. Y., 564 pp., 1952)
10. Ausubel, D. P., Balthazar, E. E., Rosenthal, I., Blackman, L. S., Schpoont, S. H., and Welkowitz, J. H., "Perceived Parent Attitudes as Determinants of Children's Ego Structure," *Child Development*, **25**, 173-84 (1954)
11. Baldwin, A. L., Kalhorn, J., and Breese, F. H., "Patterns of Parent Behavior," *Psychol. Monographs*, **58**, Ser. No. 258 (1945)
12. Barker, R. G., "Child Psychology," *Ann. Rev. Psychol.*, **2**, 1-22 (1951)
13. Bayley, N., "Mental Growth During the First Three Years: A Developmental Study of Sixty-One Children by Repeated Tests," *Genet. Psychol. Monographs*, **14**, No. 1 (1933)
14. Bayley, N., "Consistency and Variability in the Growth of Intelligence from Birth to Eighteen Years," *J. Genet. Psychol.*, **75**, 165-96 (1949)
15. Behrens, M. L., "Child Rearing and the Character Structure of the Mother," *Child Development*, **25**, 225-38 (1954)
16. Bell, R. Q., "Convergence: An Accelerated Longitudinal Approach," *Child Development*, **24**, 145-52 (1953)
17. Bell, R. Q., "An Experimental Test of the Accelerated Longitudinal Approach," *Child Development*, **25**, 281-86 (1954)
18. Bernstein, A., "Some Relations between Techniques of Feeding and Training During Infancy and Certain Behavior of Childhood," *Genet. Psychol. Monographs*, **51**, 3-44 (1955)
19. Biehler, R. F., "Companion Choice Behavior in the Kindergarten," *Child Development*, **25**, 45-50 (1954)
20. Block, J., "Personality Characteristics Associated with Father's Attitudes toward Child-Rearing," *Child Development*, **26**, 41-48 (1955)
21. Blom, G. E., "Emotional Factors in Children with Rheumatoid Arthritis," *Am. J. Orthopsychiat.*, **24**, 588-600 (1954)
22. Body, M. K., "Patterns of Aggression in the Nursery School," *Child Development*, **26**, 3-12 (1955)
23. Bonney, M. E., "Choosing between the Sexes on a Sociometric Measurement," *J. Social Psychol.*, **39**, 99-114 (1954)
24. Bossard, J. H. S., and Ball, E. S., "Personality Roles in the Large Family," *Child Development*, **26**, 71-78 (1955)
25. Bossard, J. H. S., and Ball, E. S., "Security in the Large Family," *Mental Hygiene*, **38**, 529-44 (1954)
26. Brim, O. G., Jr., "The Acceptance of New Behavior in Child Rearing," *Human Relations*, **7**, 473-91 (1954)
27. Brodbeck, A. J., "Learning Theory and Identification. IV. Oedipal Motivation as a Determinant of Conscious Development," *J. Genet. Psychol.*, **84**, 219-27 (1954)
28. Broida, D. C., and Thompson, G. G., "The Relationship between Certain Rorschach 'Insecurity' Hypotheses and Children's Reaction to Psychological Stress," *J. Personality*, **23**, 167-81 (1954)
29. Burt, C., "The Differentiation of Intellectual Ability," *Brit. J. Educ. Psychol.*, **24**, 76-90 (1954)
30. Byrd, E., and Witherspoon, R. L., "Responses of Preschool Children to the Children's Apperception Tests," *Child Development*, **25**, 35-44 (1954)
31. Calvin, A. D., "Configurational Learning in Children," *J. Educ. Psychol.*, **46**, 117-20 (1955)
- ✓ 32. Cantor, G. N., and Spiker, C. C., "Effects of Non-Reinforced Trials on Dis-

- crimination Learning in Preschool Children," *J. Exptl. Psychol.*, **47**, 256-58 (1951)
33. Caplan, G., "Clinical Observations on the Emotional Life of Children in the Communal Settlements in Israel," in Senn, M. H., *Problems of Infancy and Childhood* (Trans. 7th Conf. Josiah Macy Jr. Foundation, New York, N.Y., 196 pp., 1954)
34. Champney, H., "The Measurement of Parent Behavior," *Child Development*, **12**, 131-66 (1941)
35. Cobb, H. V., "Role Wishes and General Wishes of Children and Adolescents," *Child Development*, **25**, 161-71 (1954)
36. Coleman, R. W., Kris, E., and Provence, S., "The Study of Variations of Early Parental Attitudes," *The Psychoanal. Study of the Child*, **8**, 20-47 (1954)
37. Connor, R., Johannis, T., and Walters, R., "Parent-Adolescent Relationships. I. Parent-Adolescent Conflicts; Current and In Retrospect," *J. Home Econ.*, **46**, 183-86 (1954)
38. Connor, R., Johannis, T., and Walters, R., "Parent-Adolescent Relationships. II. Intra-Familial Conceptions of the Good Father, Good Mother, and Good Child," *J. Home Econ.*, **46**, 187-91 (1954)
39. Corcoran, A. L., "Color Usage in Nursing School Painting," *Child Development*, **25**, 107-13 (1954)
40. Ellis, A., and Beechley, R. M., "Emotional Disturbance in Children with Peculiar First Names," *J. Genet. Psychol.*, **85**, 337-39 (1954)
41. Escalona, S., Leitch, M., et al., "Early Phases of Personality Development: A Non-Normative Study of Infant Behavior," *Monographs Soc. Research Child Development*, **17**, Ser. No. 54 (1952)
42. Feinberg, H., "Achievement of Children in Orphan Homes as Revealed by the Stanford Achievement Test," *J. Genet. Psychol.*, **85**, 217-29 (1954)
43. Foshay, A. W., Wann, K. D., et al., *Children's Social Values*, (Bureau of Publications, Teachers College, Columbia University, New York, N.Y., 323 pp., 1954)
44. Fries, M. E., and Woolf, P. J., "Some Hypotheses on the Role of the Congenital Activity Type in Personality Development," *Psychoanal. Studies Child*, **8**, 48-64 (1954)
45. Graham, T. F., "Doll Play Fantasies of Negro and White Primary School Children," *J. Clin. Psychol.*, **11**, 29-33 (1955)
46. Gruber, S., "The Concept of Task Orientation in the Analysis of Play Behavior of Children Entering Kindergarten," *Am. J. Orthopsychiat.*, **24**, 326-35 (1954)
47. Haggard, E. A., "Social-Status and Intelligence: An Experimental Study of Certain Cultural Determinants of Measured Intelligence," *Genet. Psychol. Monographs*, **49**, 141-86 (1954)
48. Hardy, M. C., "Socio-Economic Background of Children with Impaired Hearing," *Child Development*, **25**, 295-308 (1954)
49. Harris, D. B., Clark, K. E., Rose, A. M., and Valasek, F., "The Relationships of Children's Home Duties to an Attitude of Responsibility," *Child Development*, **25**, 29-34 (1954)
50. Harris, D. B., Clark, K. E., Rose, A. M. and Valasek, F., "The Measurement of Responsibility in Children," *Child Development*, **25**, 21-28 (1954)
51. Heathens, G., "The Adjustment of Two-Year-Olds in a Novel Social Situation," *Child Development*, **25**, 147-58 (1954)
52. Hightberger, R., "The Relationship Between Maternal Behavior and the Child's Early Adjustment to Nursery School," *Child Development*, **26**, 49-62 (1955)

53. Hildreth, G., "Three Gifted Children: A Developmental Study," *J. Genet. Psychol.*, **85**, 239-62 (1954)
54. Hodges, A., "A Developmental Study of Symbolic Behavior," *Child Development*, **25**, 277-80 (1954)
55. Hoefflin, R., "Child Rearing Practices and Child Care Resources Used by Ohio Farm Families with Preschool Children," *J. Genet. Psychol.*, **84**, 271-97 (1954)
56. Hofstaetter, P. R., "The Changing Composition of Intelligence: A Study in T-technique," *J. Genet. Psychol.*, **85**, 159-64 (1954)
57. Holloway, H. D., "Effects of Training on SRA Primary Mental Ability (Primary) Test and WISC," *Child Development*, **25**, 253-64 (1954)
58. Illingworth, R. S., "Crying in Infants," *Brit. Med. J.*, **I**, 75-78 (1955)
59. Jeffney, W. E., "New Technique for Motivating and Reinforcing Children," *Science*, **121**, 371 (1955)
60. Josselyn, I. M., Simon, A. J., and Eells, E., "Anxiety in Children Convalescing from Rheumatic Fever," *Am. J. Orthopsychiat.*, **25**, 109-19 (1955)
61. Kahn, M. W., "Infantile Experience and Mature Aggressive Behavior of Mice: Some Maternal Influences," *J. Genet. Psychol.*, **84**, 65-75 (1954)
62. Kerlinger, F. N., "The Statistics of the Individual Child: The Use of Analysis of Variance with Child Development Data," *Child Development*, **25**, 265-76 (1954)
63. Keston, M. J., and Jiminez, C., "A Study of the Performance on English and Spanish Editions of the Stanford-Binet Intelligence Test by Spanish American Children," *J. Genet. Psychol.*, **85**, 263-69 (1954)
64. Klatskin, E. H., and Jackson, E. B., "Methodology of Yale Rooming-In Project on Parent-Child Relationship," *Am. J. Orthopsychiat.*, **25**, 81-108 (1955)
65. Koch, H. L., "The Relation of 'Primary Mental Abilities' in Five and Six-Year-Olds to Sex of Child and Characteristics of His Sibling," *Child Development*, **25**, 209-24 (1954)
66. Koch, H. L., "The Relation of Certain Family Constellation Characteristics and Attitudes of Children Toward Adults," *Child Development*, **26**, 13-40 (1955)
67. Kurke, M. I., "The Role of Motor Experience in the Visual Discrimination of Depth in the Chick," *J. Genet. Psychol.*, **86**, 191-96 (1955)
68. Langford, L. M., and Alm, O. W., "A Comparison of Parent Judgments and Child Feelings Concerning the Self-Adjustment and Social Adjustment of Twelve-Year-Old Children," *J. Genet. Psychol.*, **85**, 39-46 (1954)
69. Lasko, J. K., "Parent Behavior toward First and Second Children," *Genet. Psychol. Monographs*, **49**, 97-137 (1954)
70. Lewis, H., *Deprived Children* (Oxford University Press, New York, N. Y., 163 pp., 1954)
71. Luchins, A. S., "On the Theories and Problems of Adolescence," *J. Genet. Psychol.*, **85**, 47-63 (1954)
72. Luchins, A. S., and Fergus, R. H., "The Effect of Differential Post-Weaning Environment on the Rigidity of an Animal's Behavior," *J. Genet. Psychol.*, **85**, 51-58 (1955)
73. Maas, H. S., "The Role of Member in Clubs of Lower-Class and Middle-Class Adolescents," *Child Development*, **25**, 241-52 (1954)
74. McCarthy, D., "Language Disorders and Parent-Child Relationship," *J. Speech Hearing Disorders*, **19**, 514-23 (1954)
75. McLean, O., "Child Development: A Generation of Research," *Child Development*, **25**, 3-8 (1954)

76. MacRae, D. J., "A Test of Piaget's Theories of Moral Development," *J. Abnormal Social Psychol.*, **49**, 14-18 (1954)
77. Mannello, G., "Attitude as a Conditioner of the Acquisition of New Facts among Eighth Grade Pupils," *J. Genet. Psychol.*, **85**, 85-103 (1954)
78. Martin, W. E., "Learning Theory and Identification. III. The Development of Values in Children," *J. Genet. Psychol.*, **84**, 211-17 (1954)
79. Mead, M., "Some Theoretical Considerations on Problem of Mother-Child Separation," *Am. J. Orthopsychiat.*, **24**, 471-83 (1954)
80. Mittelman, B., "Motility in Infants, Children, and Adults: Patterning and Psychodynamics," *Psychoanal. Studies Child*, **9**, 142-77 (1954)
81. Moore, T., Hindley, C. B., and Falkner, F., "A Longitudinal Research in Child Development and Some of its Problems," *Brit. Med. J.*, **I**, 1132-37 (1954)
82. Morris, D. P., Saraker, E., Burruss, G., "Follow-Up Studies of Shy, Withdrawn Children. I. Evaluation of Later Adjustments," *Am. J. Orthopsychiat.*, **24**, 743-54 (1954)
83. Mott, S. M., "Concept of Mother: A Study of Four- and Five-Year-Old Children," *Child Development*, **25**, 99-106 (1954)
84. Moustakas, C. E., "Emotional Adjustment and the Play Therapy Process," *J. Genet. Psychol.*, **86**, 79-99 (1955)
85. Mayer, K. E., Gilmer, B. von H., "The Concept of Attention Spans in Children," *Elem. School J.*, **54**, 464-66 (1954)
86. Mummery, D. V., "Family Backgrounds of Assertive and Non-Assertive Children," *Child Development*, **25**, 63-80 (1954)
87. Paulsen, A. A., "Personality Development in the Middle Years of Childhood: A Ten-Year Longitudinal Study of Thirty Public School Children by Means of Rorschach Test and Social Histories," *Am. J. Orthopsychiat.*, **24**, 336-50 (1954)
88. Peller, L. E., "Libidinal Phases Ego-Development and Play," *Psychoanal. Studies Child*, **9**, 178-98 (1954)
89. Phillips, L., and Framo, J. L., "Developmental Theory Applied to Normal and Psychopathological Percepts," *J. Personality*, **22**, 464-74 (1954)
90. Pratt, K. C., Hartmann, W. E., and Mead, J. L., "Indeterminate Number Concepts. III. Representation by Children Through Selection of Appropriate Aggregations," *J. Genet. Psychol.*, **84**, 39-63 (1954)
91. Porter, B. M., "Measurement of Parental Acceptance of Children," *J. Home Econ.*, **46**, 176-82 (1954)
92. Rangell, L., "The Role of the Parent in the Oedipus Complex," *Bull. Menninger Clinic*, **19**, 9-15 (1955)
93. Scott, L., "Social Attitudes of Children Revealed by Responses to Television Programs," *Calif. J. Elem. Educ.*, **22**, 176-79 (1954)
94. Seward, G. H., "Learning Theory and Identification. V. Some Cultural Influences of Identification," *J. Genet. Psychol.*, **84**, 229-36 (1954)
95. Seward, J. P., "Learning Theory and Identification. II. Role of Punishment," *J. Genet. Psychol.*, **84**, 201-10 (1954)
96. Sewell, W. H., Mussen, P. H., and Harris, C. W., "Relationship Among Child Training Practices," *Am. Sociol. Rev.*, **20**, 137-48 (1955)
97. Shuttleworth, F. K., "Sexual Maturation and the Physical Growth of Girls Age Six to Nineteen," *Monographs Soc. Research Child Development*, **2**, No. 5 (1937)
98. Sigel, I. E., "The Dominance of Meaning," *J. Genet. Psychol.*, **85**, 201-7 (1954)

99. Smith, M. W., "Wild Children and the Principle of Reinforcement," *Child Development*, **25**, 115-23 (1954)
100. Spiker, C. C., and Terrell, G., "Factors Associated with Transposition Behavior of Preschool Children," *J. Genet. Psychol.*, **86**, 143-58 (1955)
101. Spitz, R. A., "Infantile Depression and the General Adaptation Syndrome; on the Relation between Physiologic Model and Psycho-Analytic Conceptualization," in *Depressions* (Hoch, P. H., and Zubin, J., Eds., Grune & Stratton, Inc., New York, N. Y., 277 pp., 1954)
102. Staples, R., and Smith, J. W., "Attitudes of Grandmothers and Mothers toward Child Rearing Practices," *Child Development*, **25**, 91-97 (1954)
103. Stendler, C. B., "Possible Causes of Overdependency in Young Children," *Child Development*, **25**, 125-46 (1954)
104. Stewart, A. H., Weiland, I. H., Leider, A. R., Mangham, C. A., Holmes, T. H., and Ripley, H. S., "Excessive Infant Crying (Colic) in Relation to Parent Behavior," *Am. J. Psychiat.*, **110**, 687-94 (1954)
105. Stewart, L., "The Expression of Personality in Drawing and Paintings," *Genet. Psychol. Monographs*, **51**, 45-103 (1955)
106. Stolz, L. M., *Father Relations of War Born Children* (Stanford University Press, Stanford, Calif., 365 pp., 1954)
107. Stone, L. J., "A Critique of Studies of Infant Isolation," *Child Development*, **25**, 9-20 (1954)
108. Strauss, A. L., "The Development of Conception of Rules in Children," *Child Development*, **25**, 193-208 (1954)
109. Stubblefield, R. L., "Children's Emotional Problems Aggravated by Family Moves," *Am. J. Orthopsychiat.*, **25**, 120-26 (1955)
110. Taback, M., "Family Studies in the Eastern Health District. VI. Family Structure and Its Changing Pattern. II. Matched Cohort Studies, Evaluation of Time Study Methods in Family Sociology, Summary and Conclusion," *Milbank Mem. Fund Quart.*, **33**, 5-49 (1955)
111. Tabanoff, L. H., and Brown, W. H. "A Study of Personality Patterns of Children and Adolescents with Peptic Ulcer Syndrome," *Am. J. Orthopsychiat.*, **24**, 602-9 (1954)
112. Temple, R., and Amen, E. W., "A Study of Anxiety Reactions in Young Children by Means of a Projective Technique," *Genet. Psychol. Monographs*, **30**, 59-114 (1944)
113. Tyler, F. T., "Organismic Growth: P-Technique in the Analysis of Longitudinal Growth Data," *Child Development*, **25**, 83-90 (1954)
114. Tyler, L. E., "The Development of Vocational Interests. I. The Organization of Likes and Dislikes in Ten-Year-Old Children," *J. Genet. Psychol.*, **86**, 33-44 (1955)
115. Wallis, R. S., "The Overt Fears of Dakota Indian Children," *Child Development*, **25**, 185-92 (1954)
116. Wattenberg, W. W., "Factors Associated with Repeating among Preadolescent 'Delinquents,'" *J. Genet. Psychol.*, **84**, 189-95 (1954)
117. Wenar, C., "The Effects of a Motor Handicap on Personality. II. The Effect on Integrative Ability," *Child Development*, **25**, 287-94 (1954)
118. Williams, J. R., and Scott, R. B., "Growth and Development of Negro Infants. IV. Motor Development and Its Relationship to Child Rearing Practices in Two Groups of Negro Infants," *Child Development*, **24**, 103-21 (1953)
119. Zelen, S. L., "Acceptance and Acceptability: An Examination of Social Reciprocity," *J. Consulting Psychol.*, **18**, 316 (1954)



# EDUCATIONAL PSYCHOLOGY<sup>1,2,3</sup>

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## INTRODUCTION

From an analysis of the content of six recent textbooks [Symonds & Jensen (117)] it is seen that there is considerable disagreement concerning the definition of educational psychology. The text writers had varying ideas about the relative significance of different types of materials; a topic that received considerable attention from some was given much less by others.

The present reviewer found that Kendall's measure of concordance ( $W$ ) for the tabular data presented by Symonds & Jensen was about .53. Nonetheless, there are noticeable differences from text to text in the relative amounts of space devoted to each topic. As a matter of fact, a large part of the value of  $W$  derives from the fact that most of the writers did give major attention to learning (which ranked first in terms of percentage of space allocated to it in four textbooks, second in one and fourth in one).

This consideration of the content of recent texts failed to provide the reviewer with information to formulate a definition of educational psychology which would represent at the same time both a median position and minor variability about it. The previous volumes of *The Annual Review of Psychology* were next consulted to determine what unanimity would be found among reviewers. It was decided, in order to eliminate the subjectivity involved in the classification of content, to determine the sources of the references selected by the reviewers. The nature of the bibliographies varied considerably from year to year; the number of different journals cited varied from 12 to more than 30; the maximum number of references to any single journal from six in one volume of the *Annual Review of Psychology* to 24 in another. The 10 journals which provided the largest number of references for the chapter on Educational Psychology in all six volumes were selected for further study. (One journal was not included because it was not available for the early volumes of the *Review*.) The frequencies of appearance of these 10 journals were ranked for each review; Kendall's  $W$  for the resulting six by ten table was about .38. There is a marked tendency therefore for reviewers to find the journals of varying significance for their purposes.

These results may, of course, reflect changes in the content of the journals

<sup>1</sup> The following abbreviations are used in this chapter: ACE (American Council on Education); KPR (Kuder Preference Record); MMPI (Minnesota Multiphasic Personality Inventory); TAT (Thematic Apperception Test).

<sup>2</sup> The reviewer wishes to acknowledge his indebtedness to the Library of the Institute of Education, University of London, for the use of their facilities in connection with the preparation of this review.

<sup>3</sup> The writer is indebted to Dean W. A. Brownell and Dr. H. D. Carter for their suggestions regarding the form and content of the manuscript.

from year to year, although it seems unusual that a journal would vary so much that it would contribute 19 papers for one review and practically none for any of the others. Too, the data may reflect differences in the availability of the journals to the different reviewers.

The differences among the reviews may also reflect the presence of divergent opinions about the nature of the concepts that are appropriate for educational psychology. One reviewer conceived it as a separate branch from psychology, a discipline in its own right; another apparently considered that it has at least some overtones with interdisciplinary connotations. Undoubtedly all reviewers would agree that the content should have reference to the learning process. Then, too, one may have been thinking of educational psychology (for purposes of the *Review*) from the point of view of the specialist, and another, that of the practitioner. Both positions are defensible. Which is really preferable for these *Reviews*? Are the positions actually different?

So we come to a consideration of Haggard's (55) discussion of the "proper concern of educational psychologists." He is of the opinion, along with the writers of several recent reports, that the field is characterized by a general state of disorder. He suspects that part of the difficulty arises from the fact that too often educational psychologists are failing to develop theories of their own and are neglecting to engage in systematic research on key problems relevant to the educative processes. Too often they appear unwilling to do their own basic research, and too often they are willing to seize upon any of the facts and theories of other disciplines which seem to have any relevance for education.

Since analyses of recent textbooks and of the references in preceding *Reviews* did not provide any unequivocal basis for formulating a generally acceptable definition of educational psychology, another source of guidance was investigated. Educational psychology has sometimes been defined as whatever educational psychologists do. We might, then define it in terms of the work of the men to whom reference is most often made in textbooks. The indexes of several recent books were consulted to discover the men that the writers considered to be educational psychologists. There was little overlap between the most commonly occurring names in one text and those in another. The number of references to James, Dewey, Kohler, and Jones varied from none to 12 and more. Thorndike appeared more than 30 times in one text, and as few as four in another.

Finally, it was decided to determine how frequently textbook writers referred to the work of certain men who would surely be considered as educational psychologists, namely, Brownell, Buswell, Carter, and McConnell (names chosen, as the reader will recognize, at random!). The work of some of these men was completely ignored in several of these textbooks. In one of them, reference was made to only one of the four. It seems unusual that an introductory textbook should have no reference to Brownell's work on learning and arithmetic, Buswell's on arithmetic and reading, Carter's on measurement, and McConnell's on learning.

After a consideration of the preceding materials, the reviewer preferred to follow Carter's definition (19): educational psychology is that branch of psychology that deals with learning as it relates to the educative process. Further, according to the same authority, an understanding of learning involves knowledge of (a) learners, (b) learning-teaching processes and products, and (c) teachers. This review is organized around these three major topics together with one other, measurement, by which much evidence essential to sound understanding and theorizing about psychological facts and concepts relevant to education is obtained.

The content of the review, representing a sampling of the available research, covers approximately the period from April, 1954, to April, 1955. In the space available it is not possible to deal critically with each paper. The reviewer attempted to relate current research to existing knowledge and only occasionally made comments about particular studies. One of the weakest aspects of research appears to be that the samples studied are limited as to the number and representativeness of subjects included.

### MEASUREMENT AND MEASURING INSTRUMENTS

Papers classified under this heading deal with three major topics: (a) psychometric problems, (b) new tests, and (c) analyses of existing tests. The emphasis is on the tests per se rather than upon revelations about learners, teachers, or learning-teaching processes.

#### PSYCHOMETRIC PROBLEMS

*Theoretical considerations: validity.*—Psychometrically-oriented educational psychologists continue their interest in problems of validity and reliability; unfortunately, some investigators of specific problems appear too often to be unconcerned about these characteristics.

Coleman & Cureton (30) found 95 per cent overlap between an intelligence test and an achievement test in grade VI. Apparently the tests measure the same function, and the use of two titles is regarded as misleading, especially in view of the practice of interpreting achievement in the light of capacity. The findings are related to the controversy concerning class bias in intelligence tests. Verbal and arithmetical items are considered to be the only bases on which to make inferences about native capacity since they constitute the common knowledge in our population.

Not all psychologists agree that "a test is valid for anything with which it correlates." Gaylord & Stunkel (46) believe that some of the confusion in mental measurement and prediction would be resolved by a more careful consideration of the meanings of the terms "validity" and "criterion" as they apply in pure and applied research.

*Theoretical considerations: reliability.*—New procedures for estimating reliability continue to appear. Horst (64) proposed a formula for obtaining immediate test reliability from the number of choices per item, the number of items, and the mean and variance of the scores. He believes that the formula parallels the concept of reliability found in the physical sciences.

Loevinger (81) discussed the effect of systematic errors on measures of reliability and upon the results of item analyses based upon various criteria.

Cronbach & Hartmann (31) pointed out that the coefficient of correlation between two halves of a test may be negative, in which case the Spearman-Brown formula can not be used, as is apparent from a consideration of the case in which the coefficient is  $-1.00$ ; application of the formula produces a meaningless result. Such tests are of doubtful value for measuring a single psychological characteristic.

*Empirical evidence about psychometric problems.*—A good deal is known about the effects of differential weighting of items and subtests upon validity and reliability. Two further contributions were reported in the period under review. Carter (20) found that weighted scores on his Study Methods Test correlated .95 and .93 with data from two systems of unweighted scoring. Weighted and unweighted scores correlated .42 and .41 with achievement scores in a cross-validation sample. In Ryans' study (106) two observers used a rating scale of seven items to rate teaching effectiveness. Unweighted scores were correlated with scores from each of nine systems of weighting; two thirds of the coefficients were .99, and all exceeded .79. Unweighted scores were also the most reliable. One wonders, with Ryans, about the need for further studies into the relationship between weighted and unweighted scores, unless the problem is radically different from any that has been reported to date.

Holmes (62) showed the effect on reliability of changing the administrative procedures of a test. The Spearman-Brown reliability coefficients for his revision of the Kwalwasser-Dykema Test were significantly higher than the mean of the coefficients reported by earlier investigators. Jeeves (68) presented a mathematical formulation of the problem encountered by Holmes of averaging different types of reliability coefficients.

#### NEW TESTS

*Intelligence.*—The search for alternative measures of intelligence continues, their acceptability commonly being contingent upon the existence of a significant correlation with an intelligence test. One wonders whether the coefficient should not be approximately unity if the new test is to be considered as an alternative (46).

Lepley (77), on the assumption that the size of an individual's synonym vocabulary is an index of intelligence, developed a "synonym" test which correlated .32 with grades in elementary psychology. The relationship of the test to intelligence, which appeared to be Lepley's real problem, is not revealed by the investigation.

Catalano & McCarthy (22) investigated the possibility of using indices derived from analyses of infants' speech to predict intelligence. The data from 23 children with IQ's varying from 57 to 102 correlated .40 with Binet IQ's. The writers were of the opinion that the method is promising and deserving of further research.

*Social behavior.*—Considerable attention is being given to problems of social behavior and interpersonal relations, possibly more in theoretical discussions than in research. Consequently tests of social behavior are of interest. Buchheimer & Pendleton (15) reported that Spearman-Brown coefficients for the Group Participation Scale were in excess of .91, and that the scores correlated .50 with instructors' ratings. They concluded tentatively that the scale provided valid and reliable evidence about social participation in classroom situations. Bernberg (9) used contrasting groups to validate his Human Relations Inventory. It differentiated between members of groups considered to represent different levels of social conformity, namely, students and inmates of California Youth prisons; the split-test reliability coefficient was .77.

Peer ratings are often used as evidence about social behavior, but they are often difficult to manipulate. Keislar (72) proposed a method of scoring certain sociometric data which is useful even when many children are not known by all the raters. The procedure also provides scores that are more valid and more nearly normal than are certain others.

#### ANALYSES OF TESTS

*Intelligence.*—The reliability of intelligence tests and subtests was reported in three papers, with considerable agreement in the findings. Clarke & Clarke (27) concluded that the Wechsler-Bellevue test results in inaccurate predictions for a considerable proportion of certified feeble-minded since they found significant gains on retests after an interval of two years. Butler (17) indicated that the Wechsler-Bellevue test is less reliable for mental defectives than for normals; nonetheless, he is of the opinion that IQ's are stable enough for diagnosis, provided they are used with the proper precautions, but that scores on the subtests are too unreliable for accurate diagnosis. Similarly, Snodgrass (112) reported that irregularities in the profiles obtained from the Terman-McNemar tests are produced by unreliability of the subtests rather than by real strengths and weaknesses on them.

Jones (70) suggested that factorial analyses of intelligence test data may provide clues about the invariance of the IQ and about the effects of environmental conditions on test performance. He identified nine primary factors in the 1937 Stanford-Binet Scale at age 13 as a result of his analysis of responses to the items at ages 12, 13, and 14.

*Norms for the MMPI.*—The MMPI is extensively used for various purposes with college students. Consequently there has been considerable interest (and some disagreement) concerning the suitability of the published norms for such populations. Goodstein (50) and Clark (26) added papers to those already available on this topic. Goodstein, on the basis of data from eight colleges in different geographical areas, concluded that regional norms were unnecessary. Both investigators found that college students differed significantly from the normative group; they were in agreement that norms for college students are necessary. The reviewer questions whether the dif-

ferences are so large that use of the published norms does result in inaccurate interpretations of the profiles.

*Validity of interest inventories.*—The second report on Tyler's (122) longitudinal study of interests appeared during the past year. It was found that sex differences in interests are established by 10 years of age. Vocational interests, according to Levine & Wallen (78), and in agreement with earlier studies, are sufficiently organized by late adolescence that they may be used to estimate future occupational activity; these investigators reported that those subjects who were working in a given interest area (KPR: Kuder Preference Record) had had higher interest scores in that area when tested in secondary school some eight years prior to the study than had those who were not engaged in work in that area. Magill's (84) study, too, may be considered a type of validation of the KPR; interest scores and patterns of college students tended to be related to the type of extracurricular activity they selected, so that, for instance, members of the band had high scores on Music.

The paper by Pierce-Jones & Carter (100) is reviewed here even though it is a report on a new type of test. Their pictorial approach to the measurement of interests appears to have much to recommend it. Reliability coefficients were in excess of .70; correlations between the pictorial scales and their cognates on the KPR were typically significant at the .01 level; correlations among the scales tended to be nonsignificant.

*Falsification of inventories.*—The possibility that responses on certain types of paper-and-pencil inventories may be faked has long been of concern, and consequently considerable evidence on the nature and extent of falsification is becoming available. Durnall's (33) subjects were able to produce a specific interest pattern on the KPR. (The ability to "adjust" responses was found to be related to intelligence.) Rabinowitz (101) showed that education students could answer the Minnesota Teacher Attitude Inventory so as to obtain different scores in accordance with two different definitions of a "good" teacher. In a third study, college women were able to change their MMPI profiles; the same data revealed that they had a stereotype regarding the kind of personality they thought school administrators desired in their teachers [Tyler (120)]. The evidence seems clear that falsification is possible; consequently, as Durnall and Rabinowitz recommend, care should be exercised when such inventories are used in situations in which falsification would be of benefit to the subject.

## LEARNERS

Some of the environmental conditions and the characteristics of the learners that affect learning are summarized in this section.

*Factors affecting test performance.*—The problem of the effects of practice and coaching is of special concern when intelligence tests are used for selection purposes for which they were not originally intended. Vernon (123), summarizing the evidence, concluded that these factors may affect some



children, especially those at the border lines set for selection, that the values to be derived from practice and coaching can be developed in a short time, and that the interpretation of a child's test score should include a consideration of the child's experience with tests.

The effect of class membership on test performance has received considerable attention during the past few years. Haggard's (54) paper is noteworthy because it represents an experimental attack upon the relationship of certain cultural factors to test performance. He administered both standard and revised tests under a variety of conditions of practice and motivation. Some significant differences between the children in different social classes were obtained with the standard tests but not with the revised ones. The latter were thought to have few items with a class bias. The nature of the revision is not clear, so that some of the results might have been different if the tests had been revised in different ways.

The eagerly-awaited Davis-Eells Test of General Intelligence or Problem Solving Ability (or "Games") was published in 1953. Few analyses of its significance have yet appeared. Geist (47) found that scores on this test correlated with Stanford-Binet data .78 in lower, .67 in middle, and .00 in upper class children. Rosenblum *et al.* (103) administered the Stanford-Binet, the Wechsler-Bellevue, the California Test of Mental Maturity, and the Davis-Eells test to 30 lower-class retarded boys. The mean IQ on "Games" was not higher than it was on the other tests, and the mean IQ on the Performance Scale of the Wechsler was significantly higher than on "Games."

*Emotional condition and performance.*—Emotional stability during the administration of an intelligence test appears to be a reasonable prerequisite for satisfactory measurement. Certain recent investigators have found little relationship between anxiety and test performance. Matarazzo *et al.* (89) reported a moderate relationship between their measures of level of anxiety and scores on the ACE; and the relationship became .00 when they used an untimed intelligence test. Lack of validity for the measure of anxiety may have produced the rather negative results.

The performance of inmates of a state penitentiary, according to Hanes & Halliday (57), was not affected by the presentation of emotion-arousing stimuli just prior to testing. Guertin (51) introduced instructions that he believed would reduce the threat inherent in the standard administration of the Wechsler-Bellevue test; according to the analysis of variance the instructions did not materially affect performance. One wonders if the subjects in the preceding investigations were actually disturbed by the stimuli. The reviewer is of the opinion that caution should be used in generalizing these results and in concluding that anxiety during a test does not affect performance.

The learning curves of students who were high on the Taylor Anxiety Scale did not differ from those of another group of students with low scores [Hughes and others (66)]; the investigators suggested that the role of anxiety depended upon the interval between trials. Conclusions about the role of



anxiety, it seems to the reviewer, must be tempered by a consideration of the validity of the scale used to measure anxiety, and by the motivation the students have to learn the materials apart from any anxiety they may have.

McKeachie and co-workers (94) attempted to relieve anxiety during examinations by permitting the students to make comments about the items. Students who were granted this permission appeared to perform better on the examination. On the other hand, directions to make comments on the items were associated with a decrement in scores.

*Age changes in mental organization.*—The recent publications dealing with age changes in mental organization have not provided unequivocal answers to the question; research is likely to continue. As a result of factorial analyses of Wechsler-Bellevue data, Gault (45) concluded against the existence of differences in degree of specialization at ages  $10\frac{1}{2}$  and  $13\frac{1}{2}$  years and for adults. Burt (16), on the other hand, believes that his own evidence is consistent with the concept of increasing specialization with increasing age and that the change is produced by maturational rather than educational conditions.

Hofstaetter (60) applied Cattell's *T*-technique procedure to test data from Bayley's longitudinal growth study and found three factors: sensorimotor alertness (ages up to 20 months); persistence (ages 20 to 40 months); and the typical concept of intelligence (40 months to 18 years). Further investigations of this type may provide interesting information about the problem of mental organization. The data of Russell's (105) study of word knowledge, an extensive investigation of the dimensions of children's vocabularies, offered some support to the concept of increasing specialization in the functions measured by his tests.

*Reasoners and reasoning.*—Several papers dealing with reasoners and reasoning are available for review. Guilford *et al.* (53) described a factorial analysis of some 54 reasoning tests. Among the factors located were: general and logical reasoning, the education of correlates, conceptual relations, and perceptual relations. Fattu and co-workers (37) investigated the nature of the relationships among such variables as anxiety, practice, and sex, on the one hand, and measures of problem solving on the other. They reported, among other findings, a negative relationship between anxiety and number of problems solved and an absence of sex differences in stereotypy. McNemar (95) was interested in discovering what characteristics differentiated good from poor reasoners; the former were found to be better able to overcome experimentally induced set and were superior on tests of deduction. Such studies as the one above may provide information that will help in planning curricula and in developing instructional materials for the improvement of reasoning.

The relative efficiency of group and of individual problem solving was the subject of two papers. Lorge and others (82) presented to both groups and individuals a problem at four levels of reality (verbal description, photographs, models, and models with manipulation). According to the analysis of

variance, team solutions were superior to those presented by individuals at each level of reality. Marquart (88) found that groups solved more problems than did individuals, but that a trend in the data implied that the top individual is likely to surpass the group as a whole. Care is needed in analyzing the data from such studies.

In this connection it is interesting to note the percentage of joint papers appearing in the *Journal of Educational Psychology* for each tenth year, beginning in 1914; they are 4, 13, 32, 27, and 39. Is there increasing recognition of the power of group thought? Are problems becoming so complex and complicated that a group attack is likely to be more profitable? Are there other conditions related to the change in percentages observed?

**Rigidity.**—Rigidity is of interest because of its supposed relationship to various behavior patterns and its influence upon reasoning. Its nature, whether general or specific, is in some doubt, although the data of two current papers are in agreement that there is no general factor. Applezweig (3) concluded that it is more meaningful to ask about the conditions under which rigidity occurs rather than about its generality. Forster *et al.* (41) found little relationship between rigidity in different situations; their subjects were not necessarily equally flexible in all problem situations. Perhaps this lack of relationship was caused by failure to include measurements covering a range of tasks involving rigidity, in which case it might prove to be a general factor affecting performance.

**Vocational interests: permanence.**—Three reports dealing with the permanence of vocational interests were in considerable agreement despite differences among them in samples, tests, and intervals between testing. Stordahl (115) and Trinkhaus (119) reported that C's on the Strong Vocational Interest Blank are the most, and B's the least, stable; the intervals between testings in the two studies were two and 15 years. Test-retest coefficients of correlation varied from the .60's to the .80's. Sixty-eight per cent of the C's were unchanged after two years, and 69 per cent of the second ratings were within one letter grade of the first after 15 years. Herzberg & Bouton (59) found that test-retest coefficients of correlation for the KPR varied from the .50's to the .80's, the interval between tests being four years.

The samples in the above studies were not large, varying from about 60 to about 140. There may have been some bias in the samples. Thus, the subjects were college students, and not all potential subjects for some of the studies took part in them.

**Other social characteristics.**—Sociometric techniques are often used to obtain data about individual differences and for classroom planning. Bonney (11) found no differences in boy-girl and girl-boy choices from grades III through VIII. A comparison of the characteristics of 12 children of high with those of 12 of low sociometric status showed that the former were more "versatile and psychologically free" [Bonney (12)]. The subjects in the high group were believed to have greater personality balance.

The results of Goodlad's (49) study of the differences between the adjust-

ments of promoted and nonpromoted children were not specially conclusive, although Goodlad did locate some 30 items from various personality tests that differentiated between the two groups of subjects at the .01 or .05 levels.

Sims (110) investigated the relationship between class membership and scores on the Bell Adjustment Inventory, finding a tendency for higher social class membership to accompany better adjustments; but  $t$  tests were larger than  $r$ 's.

### LEARNING-TEACHING: PROCESSES AND PRODUCTS

The reader's attention is drawn to several papers (not reviewed here) dealing with psychoanalytic concepts believed to be of significance in the learning process. Transference and identification were discussed in the *American Journal of Orthopsychiatry* and in the *Journal of Genetic Psychology* respectively. Perhaps specific research related to such concepts will appear in the near future.

Standlee & Mech (114) pointed to the apparent desire among educational psychologists for a theory of learning for the classroom and to the lack of relevant research. After considering the publications since 1949 they discussed the 22 papers that they believed had contributed to such a theory. The reviewer is sympathetic to the idea that learning is the core of educational psychology, but he questions whether Standlee & Mech actually located all pertinent papers.

*Studies of classical problems.*—The problem of massed and spaced learning has received considerable attention in the past. Mech and his co-workers (90) attempted to determine whether massed or spaced verbal reinforcement (praise) resulted in differential achievement in problems in arithmetic computation which were also administered in massed and distributed fashion. Performance was found to be superior under conditions of massed training.

Retroactive inhibition has also been the subject of numerous investigations. Foley (40) and Hall (56) contributed studies in which logical materials were used to study the nature of retroactive inhibition. Foley investigated the relationship of set to retroactive inhibition. Four groups of subjects worked under different sets. Foley failed to find statistically significant differences among the groups, but the direction of the differences led him to conclude that changes in mental set for the interpolated materials reduce the inhibition and that the reduction is a function of the learner's comprehension of logical relationships in the learning materials. Hall used three types of interpolated materials: unrelated to the original, related, and related but with small changes in selected sentences. The nature of the interpolations had no differential effect on retest scores.

Studies of transfer of learning per se have been practically nonexistent in recent volumes of the *Annual Review of Psychology*, and only two appear relevant at this time; yet transfer seems to the reviewer to be an area in which research is needed. He is of the opinion that certain of the recent

criticisms of modern education center around misconceptions of learning and transfer of learning.

Kostick (75) found that boys and girls in secondary school differ in their ability to transfer learning. Flournoy (39) reported that instruction in mental arithmetic in grade VI was associated with improvement in ability to solve mentally word problems presented orally, superior progress in problem solving, and better than normal progress in arithmetic. Information provided by such reports is of interest and importance, but evidence on how to maximize significant transfer would appear to be even more desirable.

*Readiness, and preparation, for learning.*—Readiness, as here conceived, may partake of either or both maturational and experiential characteristics; consequently studies of background knowledge are included in the review.

Are children handicapped by starting school prior to six years of age? Progress in the elementary grades of 54 children who entered grade I prior to age six was compared with that of 50 who entered at a later age [King (73)]. All pupils were in the same school for a period of six years. On the average on all counts, the younger children appeared to be at a disadvantage. We would be interested, however, in knowing something about the characteristics and progress of individual children. Which children failed to be promoted annually? What would happen to the younger children if instruction were adjusted to their level of development?

Storer (116) analyzed the errors made in algebra by selected pupils aged 14 and 15 years. The three main types of errors made by the better students were inability to cancel, to choose the correct denominator, and to obtain the correct numerator. There were many examples of confusions in addition and multiplication. Achievement in algebra was probably adversely affected by competence in certain arithmetical skills.

Mallinson & Sams (85) were interested in the relationship between certain scientific knowledge and intelligence and achievement in general psychology. The coefficient of correlation between intelligence and achievement was .68, which was reduced to .37 when scores on chemistry and biology tests were held constant. The writers interpreted their results to mean that achievement in general psychology is related more to intelligence than to scientific knowledge of chemical and biological facts and principles. Of course, the specific content of the tests may not have been of significance for the content of psychology. Their recommendation that it would be desirable to determine what biological and chemical knowledge is applicable to success in psychology is well taken.

The question of the desirability of preparatory work in general psychology prior to enrollment in educational psychology has frequently been raised. In general, Gladstone (48) found that students who had the preparatory course excelled the others in their achievement in educational psychology, although the differences were not all significant. One wonders if measures of achievement constitute the most desirable, or even the most complete, criterion for such a question. What of the attitudes engendered in the

students? What of the relative time and energy devoted to preparation for the examinations? And just what kinds of courses in psychology and educational psychology were involved?

Graduate students probably vary considerably in their preparation for work in statistics. Orleans & Sperling (98) analyzed the final examination papers in educational statistics for 73 graduate students. There were many gaps in arithmetical knowledge, indicating a need for some type of preparatory work to help the students receive maximum benefit from instruction in statistical procedures.

The fact that a student has selected a goal may represent readiness for learning. Weitz and others (127) found that college freshmen who indicated that they had selected a field of study were better prepared for college work, and they showed superior achievement in college, as compared with students who had no specific academic goal. The findings were more certain for the men than for the women.

Bendig & Hughes (6) prepared a test of attitudes toward a course in statistics and found that it accounted for at most 5 per cent of the differences in achievement. As a result, they concluded that teachers need to allay the fears of students and that predictive batteries should include tests of attitudes.

*Reading.*—Research in the language arts continues to command major attention, with very little research in arithmetic. Information relative to the improvement of reading appeared in several papers during the past year. Barry & Smith (4), using a variety of techniques, succeeded in improving the reading of pupils in grade IX. They concluded that gains in ability were related to the fact that teachers concentrated on the need for improvement and pupils on the possibility of self-improvement. Progress was observed to slow down when the emphasis was removed.

Lyle (83) and Seeman & Edwards (108) dealt with remedial reading cases. They consider that failure to progress in reading is a symptom of maladjustment rather than being simply an educational problem. Lyle found that the symptoms in 50 remedial reading cases centered around hysteroid characteristics and passive-dependent personalities; fixation and repetition-compulsion were related to reading disability. Seeman & Edwards attempted to improve reading by means of "therapy" in which the pupils were given opportunities for experiences designed to modify undesirable feelings and attitudes. They reported improvement in reading scores after a four-month period of therapy.

Wooster (129) used the reading-rate controller in his attempt to improve reading competence of 12 college students. Test-retest data showed no difference between the progress of these students and that of another "control" group. Unfortunately, there is some doubt that the control group could really be so regarded.

*Correlates of reading.*—Scores on reading tests may be expected to correlate with measures of general intelligence. Manolakes & Sheldon (87) re-

ported a marked change in the degree of relationship after grade IV or V, depending on the reading level of the children in those grades. Coefficients of correlation between language IQ's of the California Test of Mental Maturity and scores on the Progressive Achievement Test were less than .45 in grades I through IV or V, and in excess of .65 in the upper grades. The reason for the change in the relationship is not apparent. Bliesmer (10) obtained two groups of children with similar mental ages but dissimilar IQ's. The young, bright pupils excelled the others on practically all measures of reading achievement.

Tyler (121) was unable to verify the hypothesis found in some writings that the reading achievement of adolescent and preadolescent boys is related to certain types of sexual maturity.

*Spelling.*—Holmes (61) continues his interest in "substrata analysis," presenting data on the relationship of musical elements to spelling ability; training in certain auditory images may be useful in both readiness and remedial programs. A direct attack on spelling competence was described by Calhoun (18), who reported that under his instruction 19 fifth-graders improved more in two months of "intensive" study than in seven months of "typical" procedures.

It is sometimes asserted that clarity of exposition is adversely affected by inability to spell. Laycock (76) was unable to find substantiating evidence at the college level; he suggested that improvement in spelling competence will not necessarily lead to improvement in written vocabulary. Jensen & Jensen (69) once again found evidence for two kinds of spelling ability, one measured by recall and one by recognition tests. Of more interest was the evidence that spelling skills are not affected by instruction in shorthand.

*Instructional methodology.*—The relative effectiveness of lectures, discussions, and tutorial plans is of continuing interest. Certain criticisms of lectures appear hardly justified in the light of current reports; generally, the results favor the lecture method. In two reports [Guetzkow *et al.* (52); Ruja (104)] the students in the lecture classes obtained the higher scores on achievement examinations. In the third [Eglash (34)] there was no difference between the methods compared; as far as examinations were concerned those in the discussion groups were not handicapped.

In one study (52) more students in the lectures than in discussion or tutorial groups expressed an interest in further work in psychology. The students in the discussion groups (104) knew more names of other students than did those in the lecture group, hardly an important basis for selecting one method of instruction in preference to another.

Christensen & Stordahl (25) used a variety of instructional techniques, such as outlining, summarizing, and use of headings, which they thought would be organizational aids for the students; the devices did not affect test scores. McKeachie & Hiler (93) observed that students who were required to turn in assignments from a problem-oriented workbook obtained higher achievement scores than did students who had no workbooks.



The efficiency of any method of instruction probably depends, among other things, upon the aims. Wieder (128) wished to modify attitudes relative to racial, religious, and ethnic prejudices. Some subjects were taught by traditional lecture-discussion procedures, and others by nondirective methods and sociodrama. The latter techniques were superior for modifying the attitudes with which Wieder was concerned.

*Organization for instruction.*—Systematic evaluations of the outcomes of workshops are relatively scarce, although the procedure is widely used. Levinson (79) concluded that workshops, as far as the aims of the Workshop in Intergroup Relations at Harvard University in the summer of 1951 were concerned, are "no panacea, but they do help."

Instructional materials at the college level may be organized along either disciplinary or cross-disciplinary lines. The latter type of organization is thought by some to lead to superficial learning. Berg & Murphy (8) prepared a test on the psychological material common to a disciplinary course in psychology and to an interdisciplinary course including psychology, anthropology, and sociology. There was little difference between the achievement of the students in the two courses. The writers stated that the freshmen "in the interdisciplinary course learned as much psychology as the sophomores and above in the traditional course." The conclusion seems a little sweeping since the examination was based on 60 items representing the common content.

*Predicting achievement: secondary school.*—A popular area for study continues to be that of predicting academic achievement. Several studies typical of the many already reported appeared during the past year, together with some employing new approaches. The problem of predicting achievement in the secondary school is particularly acute in England where selection for secondary education is made at an early age. It is not surprising, therefore, to find English psychologists especially reporting on prediction studies. Fitzpatrick & Wiseman (38) are attempting to develop an interest test that will be useful in selecting children for technical secondary education. The latest form of the test has a reliability coefficient in the neighborhood of .90. Analyses of variance and factor analyses indicate that the test differentiates between children in different types of schools and that it measures characteristics other than intelligence and achievement.

Emmett (35) administered two batteries of tests in the last year of the primary school, one including the examinations used for selection, and the other tests designed to eliminate some of the stress and emphasis believed to accompany the formal battery. The multiple correlations between scores on each battery and subsequent achievement were both about .80. Nisbet (96) used scores on compositions written at 11.5 years to predict performance on an external examination administered three years later; the correlation between the two sets of scores was .74.

*Predicting achievement: college.*—The results reported in the three following studies are typical: coefficients between scores on single tests and



grade-point averages of about .40, and multiple coefficients in the .50 and .60's [Chappell (23); Chappell *et al.* (24); Anderson & Stegman (2)].

Some investigators have extended their consideration of the problem to include measures of other than the intellectual characteristics. Frick (43) found an  $r$  of .48 between grades and ACE scores and a multiple  $r$  of .64 when he added the MMPI to ACE as a predictive battery. Measures of level of aspiration were reported by Schultz & Riccui (107) to be of little value in predicting college achievement. Nonetheless, the concept may be useful; possibly their particular measures did not reflect meaningful motivation for achievement in college.

Parrish & Rethlingshafer (99) tested the hypothesis that, at a given level of intelligence, achievement in college is a function of "need to achieve" as measured by responses to the TAT. The difference in this need between the more and the less successful students was not significant for two groups of 24 students who were equated for intelligence. The hypothesis would seem to offer possibilities; the negative results may indicate that "need to achieve" is not a generalized form of behavior and that the measures were not specifically indicative of "need to achieve in college."

Frederiksen & Melville (42) were able to predict achievement somewhat more accurately for noncompulsives than for compulsives. (The coefficient of correlation between their two measures of compulsion was about zero.) The reviewer is unable to share their apparent enthusiasm about the possibility of improving prediction by finding subgroups; it may be possible to do so, but the evidence is not very apparent in their data.

Another aspect of the problem of prediction was investigated by Bendig & Sprague (7) who discovered a curvilinear relationship between level of achievement (the mean of the scores on several tests) and fluctuation of achievement (the range of scores on the tests); they reasoned, accordingly, that level is an impure criterion of differences in achievement. Further attention to the nature of the criterion may result in improved predictions of academic success.

*Measuring achievement.*—Problems associated with the measurement of achievement are not completely neglected, although few of the papers are concerned with new types of problems. That response set is of minor significance in multiple choice items was verified by Rapaport & Berg (102); that correcting objective items for guessing is a questionable practice was indicated by Jackson (67).

Carter (21) sought evidence regarding the ability of students to give valid opinions regarding the significance or triviality of test items. Ratings of importance were not found to be valid predictors of the discriminative power of an item. Negatively discriminating items, if sufficiently easy, often received favorable ratings. Carter considers that a valid opinion about the importance of an item is dependent upon comprehensive and penetrating knowledge of the subject matter of the test.

Daniels (32) prepared three types of tests to measure achievement in

geography in the secondary school, namely, essays, interpretative questions, and objective items. The reliabilities were .78, .74, and .84, and the coefficients of correlation with teachers' ratings of the students' geographical ability were .72, .56, and .55 respectively. Daniels concluded that "the objective-type of test was neither more reliable nor more valid than was the essay examination." The evidence varied somewhat from school to school, implying that the results may have reflected different instructional aims. Also, the tests may not have been of functionally equivalent length, and the skill with which the different tests were prepared may have affected the results. The reviewer wonders if the implications are as clear-cut as Daniels appears to believe.

Nisbet (96) reported that English compositions can be marked with a high degree of reliability. The reliability coefficient based upon an analytic procedure was .86; the reliability of the marks of four examiners using a quick impressionistic method was .96. Vernon & Millican (124) doubt that it is possible for a single examiner to assess English ability from a single essay examination; but they did obtain a reliability coefficient of .83 for two examiners marking seven essays.

*Learning and study attitudes.*—The coefficients of correlation between scores on tests of study methods and study attitudes and grades in three papers are in considerable agreement, typically varying between .40 and .50 [Brown & Holtzman (13); Carter (20); Holtzman *et al.* (63)]. Possibly more important is the agreement that attitudinal factors are more effective determiners of success than are the mechanics of study.

This condition is apparent in Carter's paper in which the least important factor revealed by the factorial analysis included the items dealing with methods of study. Brown and his co-workers (14) reached the same conclusion as a result of analyzing the behavior of superior and inferior college students in their responses to requests that they co-operate in a testing program, and to opportunities to prepare for examination. The poorer students tended to procrastinate and to be unwilling to conform to academic requirements. As Carter pointed out, counsellors need to work on attitudes, not simply on the mechanics of study.

*Other conditions affecting learning.*—Individuals in groups appear to react to success and failure much as they do when working as individuals [Shelley (109)]: the individual's level of aspiration toward a group goal depends upon the success the group had in earlier problem situations. The relation of such evidence to morale is apparent.

Coladarci *et al.* (29) found that high school seniors thought they better understood the content of lectures when they were delivered by persons of high prestige value than by those of lesser prestige. There is considerable evidence that attitude is a determiner of learning. Mannello's (86) results with eighth-grade pupils were rather negative: attitude apparently played but a modest part in learning. It may be that the significance of the attitude to the individual is the factor that determines whether it will affect the learning process.

Spitzer (113) reported that children in classes of at least 30 excelled those in classes of at most 26 on three of four standardized tests. The problem of class size is of considerable interest because of the present shortage of teachers. One wonders, of course, if achievement on subject matter tests is the best, or the only, criterion for determining size of class in the elementary school.

*Some guidance problems.*—Kaess & Long (71) investigated the effectiveness of vocational guidance by means of grade-point averages and questionnaires dealing with job satisfaction. The investigators pointed to the need for multiple criteria and control groups in such studies. Hoyt (65), after defining the aims of a vocational guidance program, evaluated the extent to which such aims were attained by individual and group guidance procedures. He found no significant differences between the results of the two techniques.

Does the taking of a test change a subject's ratings of his own abilities and interests? Froehlich (44) found marked stability in the self-ratings of his subjects before and after taking a battery of tests. Only in four areas, on an interest test, did the subjects make significant changes in their ratings.

### TEACHERS

One of the largest single group of studies reviewed contains those dealing with the evaluation and prediction of teaching competence. This is interesting since the present teacher shortage makes it difficult to employ rigorous selection procedures; nonetheless, valid evidence about the qualities of competent teachers might result in the formulation of effective recruitment programs.

*Criteria of teaching effectiveness.*—The major problems in prediction studies are, of course, those of the criteria and of the predictive instruments. Criteria may be measures of pupil growth or ratings by pupils and adults. According to the data reported by Webb & Nolan (126), these constitute relatively distinct measures of teaching efficiency; the coefficient of correlation, for instance, between supervisory and pupil ratings was approximately zero. Anderson (1) concluded from the study of several criteria that there is no adequate method of validating teacher evaluations.

Pupil and student ratings are considered by some to be unsuitable measures of a teacher's competence. (One is reminded of Carter's (21) conclusion that ability to give valid opinions about the importance of test items depends upon sound knowledge in the field of the test.) Bendig (5) factor analyzed data dealing with the rated competence of 11 psychology instructors. The three factors (similar to those found in another study with high school teachers) were termed: halo, competence, and personality (especially empathy). Coffman (28) analyzed the data from 19 ratings for each of 55 college instructors. He concluded (and Bendig would probably agree) that the students did select important items of behavior when they rated their instructors; the factors were termed empathy, abilities to organize and to systematize, and verbal fluency. Lindgren (80) considers that, with further

research, some modification of the sentence completion test is likely to offer interesting possibilities as an evaluative instrument.

*Prediction of teaching success.*—Several investigators recently published papers dealing with the prediction of teaching success. Montross (92) reported a multiple coefficient of correlation of about .70 between measures of success and various objective measures. Nearly half of Singer's (111) coefficients among measures of success and social competence and between these two measures were only as large as .30; possibly 20 per cent of the predictive coefficients reported by Erickson (36) exceeded .20. None of these results appears particularly promising; predictions and cross-validations would probably have proven even more disappointing.

The study by Michaelis (91) is one of the few investigations in which predictions in cross-validation samples were reported. Despite the careful control of the samples and the use of reliable personality test data, Michaelis was unable to find any predictive data that withstood satisfactorily the ravages of cross-validation. In general, the results of the preceding studies are similar to those already known, though there are marked differences in interpretation.

Wandt (125) developed a scale to measure a teacher's attitude toward children, administrators, and other educational personnel. Superior teachers (as rated by principals) had more favorable attitudes toward children and administrators than had the less successful. Ohlsen & Schultz (97) used an adaptation of the TAT to study the responses of student teachers who had been rated by their supervisors at the extremes of teaching competence; about 20 per cent of the comparisons showed differences significant at the .01 level.

A suggestion for the study of teaching success is found in the work of Hawkes & Egbert (58), although their study of "empathy" and personal values was rather negative. The hypothesis might be worthy of further consideration since empathy was found to be a factor in students' ratings of teaching competence.

There are probably many reasons for the generally unsatisfactory attempts to predict teaching success. Among these may be the failure to control relevant characteristics of the samples. For instance, Teevan (118) accepts the idea that there is a relationship between a student's personality and his field of undergraduate specialization. While his evidence is very tenuous, it is in agreement with some earlier suggestions to the same effect.

Koile (74) was interested in the possibility of developing a test that would be useful in selecting college counsellors. An inventory based upon responses of college teachers, some of whom were engaged in counselling and others were not, enabled Koile to predict membership in one or the other of the two groups with about 80 per cent accuracy in a cross-validation group. The weakness of the procedure for his purpose, namely to select college teachers who are interested in counselling, is apparent.

### A BACKWARD GLANCE AND A FORWARD LOOK

The reviewer finds it difficult to say anything original about current research, something that has not been said by previous reviewers about what

was current research to them, about its contributions, its strengths and weaknesses, and its trends. The nature of research does not change so rapidly that it is possible to indicate something new about it year by year. Many of the comments of the previous reviewers are still apropos: individual contributions are a mixed bag; too many studies begin and end in themselves; too many of the investigations suffer from some blight; some problems are overstressed, and others are given too little attention; research is not systematized around crucial problems; too many findings are tentative. Another page along the same lines could be written; but this reviewer prefers to conclude with a positive, forward look at a possible type of future for research in educational psychology.

The research of the past 40 years may present the appearance of a patchwork quilt, but it is possible that from its many parts we can obtain facts, concepts, and principles that complement and supplement each other to the extent that the beginnings, at least, of a conception of learning for the classroom will emerge. It is to be expected that there will be gaps, but the formulation of a description of classroom learning should point to problems that need attention; then future research may give the appearance of coordination and integration rather than of specificity and heterogeneity. This would not necessarily imply that every piece of research would make a significant contribution to educational problems; after all only a small fraction of research is likely to warrant the label "significant." At least future educational psychologists might direct their energies toward recognized gaps in our knowledge.

The formulation of a theory, or even a description, of learning in the classroom can be expected to demonstrate that learning is a much more complex process than has perhaps been recognized in many studies, for it must deal with children, with all their motivations, with teachers and theirs, and with the processes of learning. Research into massed and distributed practice, retroactive inhibition, transfer, attitudes, and methodology involves learners learning something in some kind of an environment. Research on learning can be expected to be seen as a very intricate matter when learners, teachers, and processes are all taken into consideration.

The reviewer would hope that some individual (or perhaps it requires the combined efforts of a group) will attempt the task of sifting the research that seems pertinent to discover whether there is a pattern inherent in what may appear at present to be a mass of unsystematized, tentative findings. Such an analysis, it is believed, would provide practical information for the practitioner, theoretical material for the specialist, and answers to some of the criticisms of modern education.

#### LITERATURE CITED

1. Anderson, H. M., *J. Exptl. Educ.*, **23**, 41-71 (1954)
2. Anderson, M. R., and Stegman, E. J., *Educ. Psychol. Measurement*, **14**, 722-23 (1954)
3. Applezweig, D. G., *J. Abnormal Social Psychol.*, **49**, 224-28 (1954)
4. Barry, R. F., and Smith, P. E., *J. Educ. Psychol.*, **45**, 407-14 (1954)

5. Bendig, A. W., *J. Educ. Psychol.*, **45**, 385-93 (1954)
6. Bendig, A. W., and Hughes, J. B., II, *J. Educ. Psychol.*, **45**, 268-76 (1954)
7. Bendig, A. W., and Sprague, J. L., *J. Appl. Psychol.*, **38**, 409-13 (1954)
8. Berg, I. A., and Murphy, R. J., *J. Educ. Psychol.*, **45**, 365-71 (1954)
9. Bernberg, R. E., *J. Psychol.*, **39**, 89-96 (1955)
10. Bliesmer, E. P., *J. Educ. Psychol.*, **45**, 321-31 (1954)
11. Bonney, M. E., *J. Social Psychol.*, **39**, 99-114 (1954)
12. Bonney, M. E., *J. Educ. Research*, **48**, 481-95 (1955)
13. Brown, W. F., and Holtzman, W. H., *J. Educ. Psychol.*, **46**, 75-84 (1955)
14. Brown, W. F., Abeles, N., and Iscoe, I., *J. Educ. Psychol.*, **45**, 215-23 (1954)
15. Buchheimer, A., and Pendleton, P., *Educ. Psychol. Measurement*, **14**, 566-69 (1954)
16. Burt, C., *Brit. J. Educ. Psychol.*, **24**, 76-90 (1954)
17. Butler, A., *Am. J. Mental Deficiency*, **59**, 80-84 (1954)
18. Calhoun, R. T., *Elem. School J.*, **55**, 154-57 (1954)
19. Carter, H. D., *Ann. Rev. Psychol.*, **4**, 387-406 (1953)
20. Carter, H. D., *Calif. J. Educ. Research*, **6**, 26-32 (1955)
21. Carter, H. D., *Calif. J. Educ. Research*, **6**, 61-71 (1955)
22. Catalano, F. L., and McCarthy, D., *J. Psychol.*, **38**, 203-9 (1954)
23. Chappell, T. L., *J. Educ. Psychol.*, **46**, 53-55 (1955)
24. Chappell, T. L., Callis, R., Renzaglia, G. A., and Spohrer, M. A., *Educ. Psychol. Measurement*, **14**, 724-25 (1954)
25. Christensen, C. M., and Stordahl, K. E., *J. Educ. Psychol.*, **46**, 65-74 (1955)
26. Clark, J. H., *J. Social Psychol.*, **40**, 319-21 (1954)
27. Clarke, A. D. B., and Clarke, A. M., *Brit. J. Psychol.*, **45**, 173-79 (1954)
28. Coffman, W. E., *J. Educ. Psychol.*, **45**, 277-86 (1954)
29. Coladarcis, A. P., Elson, E. F., and Finis, K., *Calif. J. Educ. Research*, **5**, 202-8 (1954)
30. Coleman, W., and Cureton, E. E., *Educ. Psychol. Measurement*, **14**, 347-51 (1954)
31. Cronbach, L. J., and Hartmann, W., *Educ. Psychol. Measurement*, **14**, 342-46 (1954)
32. Daniels, J. C., *Brit. J. Educ. Psychol.*, **24**, 180-89 (1954)
33. Durnall, E. J., Jr., *J. Educ. Psychol.*, **45**, 240-43 (1954)
34. Eglash, A., *J. Educ. Psychol.*, **45**, 257-67 (1954)
35. Emmett, W. G., *Brit. J. Educ. Psychol.*, **24**, 91-98 (1954)
36. Erickson, H. E., *J. Exptl. Educ.*, **23**, 1-39 (1954)
37. Fattu, N. A., Kapos, E., and Mech, E. V., *Genet. Psychol. Monographs*, **50**, 141-85 (1954)
38. Fitzpatrick, T. F., and Wiseman, S., *Brit. J. Educ. Psychol.*, **24**, 99-105 (1954)
39. Flournoy, M. F., *Elem. School J.*, **55**, 148-53 (1954)
40. Foley, D. P., *J. Gen. Psychol.*, **50**, 261-67 (1954)
41. Forster, N. C., Vinacke, W. E., and Digman, J. M., *J. Abnormal Social Psychol.*, **50**, 211-16 (1955)
42. Frederiksen, N., and Melville, S. D., *Educ. Psychol. Measurement*, **14**, 647-56 (1954)
43. Frick, J. W., *J. Appl. Psychol.*, **39**, 49-52 (1955)
44. Froehlich, C. P., *Calif. J. Educ. Research*, **5**, 166-69 (1954)
45. Gault, U., *Australian J. Psychol.*, **6**, 85-89 (1954)

46. Gaylord, R. H., and Stunkel, E. R., *Educ. Psychol. Measurement*, **14**, 294-300 (1954)
47. Geist, H., *Calif. J. Educ. Research*, **5**, 209-14 (1954)
48. Gladstone, R., *J. Educ. Psychol.*, **45**, 415-20 (1954)
49. Goodlad, J. I., *J. Exptl. Educ.*, **22**, 301-328 (1954)
50. Goodstein, L. D., *J. Consulting Psychol.*, **18**, 437-41 (1954)
51. Guertin, W. H., *J. Genet. Psychol.*, **85**, 79-83 (1954)
52. Guetzkow, H., Kelly, E. L., and McKeachie, W. J., *J. Educ. Psychol.*, **45**, 193-207 (1954)
53. Guilford, J. P., Christensen, P. R., Kettner, N. W., Green, R. F., and Hertzka, A. F., *Educ. Psychol. Measurement*, **14**, 301-25 (1954)
54. Haggard, E. A., *Genet. Psychol. Monographs*, **49**, 141-86 (1954)
55. Haggard, E. A., *Am. Psychologist*, **9**, 539-43 (1954)
56. Hall, J. F., *J. Educ. Psychol.*, **46**, 47-52 (1955)
57. Hanes, B., and Halliday, R. W., *J. Genet. Psychol.*, **85**, 151-54 (1954)
58. Hawkes, G. R., and Egbert, R. L., *J. Educ. Psychol.*, **45**, 469-76 (1954)
59. Herzberg, F., and Bouton, A., *Educ. Psychol. Measurement*, **14**, 326-31 (1954)
60. Hofstaetter, P. R., *J. Genet. Psychol.*, **85**, 159-64 (1954)
61. Holmes, J. A., *J. Exptl. Educ.*, **22**, 329-49 (1954)
62. Holmes, J. A., *J. Genet. Psychol.*, **85**, 65-73 (1954)
63. Holtzman, W. H., Brown, W. F., and Farquhar, W. G., *Educ. Psychol. Measurement*, **14**, 726-32 (1954)
64. Horst, P., *Educ. Psychol. Measurement*, **14**, 705-8 (1954)
65. Hoyt, D. P., *J. Appl. Psychol.*, **39**, 26-30 (1955)
66. Hughes, J. B., II, Sprague, J. L., and Bendig, A. W., *J. Psychol.*, **38**, 421-26 (1954)
67. Jackson, R. A., *Educ. Psychol. Measurement*, **15**, 74-79 (1955)
68. Jeeves, T. A., *J. Genet. Psychol.*, **85**, 75-77 (1954)
69. Jensen, B. T., and Jensen, J. W., *J. Educ. Psychol.*, **46**, 112-16 (1955)
70. Jones, L. V., *J. Genet. Psychol.*, **84**, 125-47 (1954)
71. Kaess, W., and Long, L., *Educ. Psychol. Measurement*, **14**, 423-33 (1954)
72. Keislar, E. R., *J. Educ. Psychol.*, **45**, 151-60 (1954)
73. King, I. B., *Elem. School J.*, **55**, 331-36 (1955)
74. Koile, E. A., *Educ. Psychol. Measurement*, **15**, 47-57 (1955)
75. Kostick, M. M., *J. Educ. Psychol.*, **45**, 449-58 (1954)
76. Laycock, F., *J. Educ. Psychol.*, **45**, 485-91 (1954)
77. Lepley, W. M., *J. Psychol.*, **39**, 215-25 (1955)
78. Levine, P. R., and Wallen, R., *J. Appl. Psychol.*, **38**, 428-31 (1954)
79. Levinson, D. J., *J. Psychol.*, **38**, 103-26 (1954)
80. Lindgren, H. C., *J. Social Psychol.*, **40**, 79-92 (1954)
81. Loevinger, J., *Educ. Psychol. Measurement*, **14**, 441-48 (1954)
82. Lorge, I., Tuckman, J., Aikman, L., Spiegel, J., and Moss, G., *J. Educ. Psychol.*, **46**, 17-24 (1955)
83. Lyle, J. G., *Australian J. Psychol.*, **6**, 191-99 (1954)
84. Magill, J. W., *J. Appl. Psychol.*, **39**, 53-56 (1955)
85. Mallinson, G. G., and Sams, C. C., *J. Educ. Research*, **48**, 29-36 (1954)
86. Mannello, G., *J. Genet. Psychol.*, **85**, 85-103 (1954)
87. Manolakes, G., and Sheldon, W. D., *Elem. School J.*, **55**, 346-50 (1955)
88. Marquart, D. I., *J. Social Psychol.*, **41**, 103-13 (1955)



89. Matarazzo, J. D., Ulett, G. A., Guze, S. B., and Saslow, G., *J. Consulting Psychol.*, **18**, 201-5 (1954)
90. Mech, E., Kapos, E., Hurst, F., and Auble, D., *J. Psychol.*, **37**, 251-56a (1954)
91. Michaelis, J. U., *Univ. Calif. Publ. Educ.*, **11**, 415-84 (1954)
92. Montross, H. W., *J. Exptl. Educ.*, **23**, 73-97 (1954)
93. McKeachie, W. J., and Hiler, W., *J. Educ. Psychol.*, **45**, 224-32 (1954)
94. McKeachie, W. J., Pollie, D., and Speisman, J., *J. Abnormal Social Psychol.*, **50**, 93-98 (1955)
95. McNemar, O. W., *Am. J. Psychol.*, **68**, 20-36 (1955)
96. Nisbet, J. D., *Brit. J. Educ. Psychol.*, **25**, 51-54 (1955)
97. Ohlsen, M. M., and Schultz, R. E., *Educ. Psychol. Measurement*, **15**, 18-27 (1955)
98. Orleans, J. S., and Sperling, J. L., *J. Educ. Research*, **48**, 177-86 (1954)
99. Parrish, J., and Rethlingshafer, D., *J. Gen. Psychol.*, **50**, 209-26 (1954)
100. Pierce-Jones, J., and Carter, H. D., *Educ. Psychol. Measurement*, **14**, 671-79 (1954)
101. Rabinowitz, W., *Educ. Psychol. Measurement*, **14**, 657-64 (1954)
102. Rapaport, G. M., and Berg, I. A., *Educ. Psychol. Measurement*, **15**, 58-62 (1955)
103. Rosenblum, S., Keller, J. E., and Papania, N., *J. Consulting Psychol.*, **19**, 51-54 (1955)
104. Ruja, H., *J. Exptl. Educ.*, **22**, 385-94 (1954)
105. Russell, D. H., *Univ. Calif. Publ. Educ.*, **11**, 315-414 (1954)
106. Ryans, D. G., *Educ. Psychol. Measurement*, **14**, 449-58 (1954)
107. Schultz, D. G., and Ricciuti, H. N., *J. Gen. Psychol.*, **51**, 267-75 (1954)
108. Seeman, J., and Edwards, B., *J. Consulting Psychol.*, **18**, 451-53 (1954)
109. Shelley, H. P., *J. Social Psychol.*, **40**, 149-64 (1954)
110. Sims, V. M., *J. Social Psychol.*, **40**, 323-27 (1954)
111. Singer, A., Jr., *J. Exptl. Educ.*, **23**, 99-131 (1954)
112. Snodgrass, F. T., *J. Educ. Psychol.*, **45**, 129-42 (1954)
113. Spitzer, H. F., *Elem. School J.*, **55**, 82-86 (1954)
114. Standlee, L., and Mech, E., *J. Educ. Research*, **48**, 355-67 (1955)
115. Stordahl, K. E., *J. Appl. Psychol.*, **38**, 423-27 (1954)
116. Storer, W. O., *Educ. Review*, **6**, 190-97 (1954)
117. Symonds, P. M., and Jensen, A. R., *J. Educ. Psychol.*, **46**, 56-64 (1955)
118. Teevan, R. C., *J. Consulting Psychol.*, **18**, 212-14 (1954)
119. Trinkhaus, W. K., *Educ. Psychol. Measurement*, **14**, 641-46 (1954)
120. Tyler, F. T., *Calif. J. Educ. Research*, **5**, 195-201 (1954)
121. Tyler, F. T., *J. Educ. Psychol.*, **46**, 85-93 (1955)
122. Tyler, L. E., *J. Genet. Psychol.*, **86**, 33-44 (1955)
123. Vernon, P. E., *Brit. J. Educ. Psychol.*, **24**, 57-63 (1954)
124. Vernon, P. E., and Millican, G. D., *Brit. J. Stat. Psychol.*, **7**, 65-74 (1954)
125. Wandt, E., *Educ. Psychol. Measurement*, **14**, 418-22 (1954)
126. Webb, W. B., and Nolan, C. Y., *J. Educ. Psychol.*, **46**, 42-46 (1955)
127. Weitz, H., Clarke, M., and Jones, E., *Educ. Psychol. Measurement*, **15**, 28-38 (1955)
128. Wieder, G. S., *J. Educ. Psychol.*, **45**, 323-44 (1954)
129. Wooster, G. F., *J. Educ. Psychol.*, **45**, 421-26 (1954)

# COMPARATIVE PSYCHOLOGY<sup>1</sup>

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## INTRODUCTION

The problem of defining comparative psychology has not yet been solved. Since it is usually considered to be a method rather than an area of psychological investigation, it has, at least in this country, no substantial subject matter of its own. In most cases comparative psychology is confused with learning experimentation involving animals or, sometimes, with any experiments in which animals are used. The increased emphasis which makes scientific respectability synonymous with "the bloodstained lab coat" lessens the likelihood that the necessary basic research will be accomplished. One reason that the studies which could provide such a foundation for the field have been unfavorably regarded by psychologists is that some of these researches have been done by naturalists. Two subjects, however, are receiving considerable attention by American psychologists, namely, the critical ages at which certain experiences may occur and the analysis of behavior in a direction away from statistical averages. For the past decade both of these have been the concern of European ethologists.

A brief comment on last year's *Annual Review* section on "Comparative Psychology" may in be order. Although Meyer (44) presented an extremely good coverage of the field, he also led up to what are, in the opinion of the present reviewer, some unfortunate implications. The first of these was that ethologists have produced only theoretical papers in which they speculate on vague constructs. It would seem that almost the exact opposite is true. A tremendous body of accurate data has been published, albeit along with some, perhaps unfortunate, theoretical material. The American answer to this work has not been consistent with the scientific attitude. No research has been done to test any of the hypotheses advanced by Lorenz and others. Instead, polemic articles have been written, the crowning example being Lehrman's critique (38) of Lorenz. That the effort expended by these same critics could be applied along much more useful lines is clear from Lehrman's precise analysis of the brooding behavior of ring doves (39).

Another implication of Meyer's review was that ethologists have some peculiar bedfellows. Nearly all the papers he listed as examples of ethological studies in the last part of his review were written by people who were using ethological data as a basis for propounding rather wild notions. Those ethological studies which Meyer considered legitimate were slipped into other parts of his review in such a manner that any associations with ethology were obscured.

<sup>1</sup> The survey of the literature pertaining to this review was completed in May, 1955.

During the past year two books have been published which should be of major interest to comparative psychologists. The first is von Frisch's *The Dancing Bees* (17). It is an admirable account of controlled behavioral research in the laboratory and in the field, and might serve as an object lesson for those experimenters who feel that precise research can be done only with elaborate and costly equipment. This is the first time that all of von Frisch's material is easily available to those who do not read German.

The second book is by Fink (12) and has the misleading title *Mind and Performance*. It is another of the many attempts to find a single measure which will do the job of evaluating intelligent behavior along the phylogenetic continuum. By using an "Arrow maze," which possesses some features of a four-way multiple-choice apparatus, Fink concludes that general learning ability for all species can be ordered in the following manner: man, domestic pig, dog, goat, white rat, chicken, rabbit, cat, turtle, and tortoise. While the attempt to make a truly comparative study of learning is laudable, there is little that this particular type of research can contribute to comparative psychology.

In marked contrast to Fink's attempt is the work now being done by Brady (7) and by Sidman & Stebbins (65), using the rat, the cat and the monkey. It is extremely encouraging to find that the same basic behavioral laws are becoming evident in such divergent species.

#### SENSORY PROCESSES AND SENSORY LEARNING

Since the reciprocity between learned performance and sensory capacities is so great that it is sometimes difficult to separate them, the two will be reviewed together in this section.

The light reactions of sawfly larvae and fall webworm larvae have been reported on by Green (20) and by Wellington, Sullivan & Henson (78), respectively. Green used two species of the sawfly to demonstrate remarkable changes in light orientation to the variables to point-diffuse light source, temperature, starvation, and instar stage. Such findings indicate the desirability of a reanalysis of the data of earlier experiments on the reactions of larvae to light. The Wellington group found similar results in the fall webworm. This group, however, went on to show that starvation appears to lower the temperature threshold at which the change to light orientation takes place. Outdoors, larvae will orient with respect to the sun, moving toward it when cooled and away from it when warmed; but larvae at any temperature maintain orientation to polarized light and will respond to rotation of an overhead polarizer through 90 degrees by changing direction a corresponding amount.

Newth & Ross (48) and Steven (71) have investigated the dermal photoreceptors of the hagfish. Spectral sensitivity was found to be maximum between 500 and 520 m $\mu$ ; above 600 m $\mu$  in wavelength the hags are virtually

insensitive to light. Estimates of the penetration of light through sea water suggest that the animal's light sensitivity is of functional value.

Gunter (22) has done a behavioral study as a check on the results of Granit, who, by the use of the microelectrode technique on the retina of the cat, an animal believed to be colorblind, found narrow response curves with maximum sensitivity in the red, green and blue spectral regions. He found no discrimination, after 950 trials, between lights from eight different spectral regions which had been matched in brightness by the animals themselves. The local application of homatropine on later trials ruled out effects of pupillary constriction. We are left with the mystery of why an animal should have selective color sensitivity in the retinal cells but apparently not in the cortex.

Sensory learning this year is represented in papers on the pigeon and the canary. Jones (32) used a modified Skinner box to test the distinctiveness of color, form, and position cues in six experimentally naive pigeons. The results suggest a greater difficulty in discriminating form than either position or color. Data on position and color were interpreted by Jones as contradicting the belief that position habits represent the most frequent systematic responses made by animals at the beginning of a discrimination problem.

The nature and extent of transfer of an acquired visual-figure discriminatory response in the pigeon have been investigated by Towe (74), and the extent of the transfer has been shown to be at least as great in the pigeon as in the mammalian forms which have been studied. The transfer is not based upon response to class-form or to specific shape, nor has any single stimulus aspect been found essential to successful transfer.

Pastore (50, 51) trained three canaries to respond to the odd stimulus of a set of otherwise identical stimuli. Such training survived the reversal of stimulus values.

Harlow & McClearn (23) have shown that in rhesus monkeys there is a progressive improvement in performance on nonspatial, object-quality discrimination problems in the absence of homeostatic drive reduction. The animals learned the discrimination problems when manipulation of objects was the only apparent incentive. Butler & Harlow (9) studied the persistence of visual exploration in normal and brain-damaged rhesus monkeys. The first experiment involved testing six animals four continuous hours a day for five days on a color discrimination problem, the sole reward being the opportunity to look out a window at the surrounding environment. No indication of a satiation effect was found, nor any significant increase in response latency. In a second experiment seven monkeys were tested for one continuous session on a similar discrimination problem until they ceased responding to the visual incentives. The data suggest that animals with bilateral damage to the temporal lobes have a depressed visual exploration motive while frontal animals do not.

## ORIENTATION

Research on the orientation of birds has continued. Of particular interest is the demonstration of a compass orientation based upon the sun's position. This process, which has been studied mainly in starlings and pigeons, depends in addition upon a 24 hr. activity cycle which acts as the "internal clock" required for sun compass orientation. The existence of a 24 hr. activity rhythm in the starling was clearly demonstrated by Rawson (57). Under constant conditions (light, sound, temperature), a continuation of this 24 hr. pattern lasted for as long as two weeks. Attempts to produce artificial "days" starting and ending 6 hr. after normal sunrise and sunset shifted the activity pattern of one of his starlings by 6 hr. within four days. A 36 hr. exposure to such a shifted schedule was insufficient to change the same animal's activity rhythm.

In a similar series of experiments Hoffmann (30) showed that throughout a period of 28 days, with reasonably constant conditions the compass direction to which starlings were trained did not vary. Four to six days proved necessary to produce consistent alterations in the birds' choice of direction when an artificial "day" was used. Restoration to the original pattern required only two days. [Briefer reports regarding Hoffmann's experiments are also available (28, 29).]

Matthews (42) conducted an experiment on that part of the sun navigation hypothesis which suggests that birds can detect longitude displacement by a comparison of home time (provided by an inferred "chronometer") with local time (estimated from the highest point of the sun's arc). When pigeons exposed for 10 days to an artificial "day" which was 3 hr. in advance of normal showed no loss in time orientation, they were next exposed to four to five "days" of irregular light/dark sequences followed by five to eleven "days" of regular sequences, advanced or retarded with respect to the normal day. Tests from the west, east, and north indicated that the "chronometers" of the birds had been affected; the pigeons tended to fly in the predicted false direction, east after an advanced day and west after a retarded one.

Pratt (53) and Pratt & Thoules (54) investigated the homing ability of pigeons. Both trained and untrained birds showed a statistically significant tendency to disappear from the experimenter's sight in the homeward half of the release cycle. Both groups displayed about the same homing success and speed, a similarity which was contrary to Matthew's results and which was attributed by Pratt to differences in stock. Another possible answer lies in the fact that Matthews did not give his pigeons free range of the home loft, while Pratt did; the restricted animals simply may not have been able to recognize their home territory upon arrival in the vicinity.

Pardi (49) reports that the terrestrial isopod *Tylos latreillii* possesses an orientation reaction similar to that of the arthropod *Talitrus saltator* which enables it to return to the water at right angles to the coastline when it is

displaced into a dry region. It can orient itself correctly even though liberated at a considerable distance from the shore. By utilizing a mirror, Pardi was able to show that these animals orient themselves by the position of the sun. There is an indication that the polarized light of the sky can be used for orientation. Additional mirror experiments indicated that the isopods can orient themselves correctly during clear nights at about full moon.

In a summary paper, von Frisch & Lindauer (18) discuss experiments which indicate that in some instances bees may utilize landmarks and natural boundaries in preference to the sun compass direction.

Vowles has published two papers on the orientation of ants (76, 77). The first paper reports that the ant's successive orientations to gravity and to light are correlated, as are those to light and polarized light, but not those to polarized light and gravity. Vowles' second paper concerns location of the ant's receptor for gravity, and the results indicate its location in the antenna.

Birukow (6) showed that the beetle *Geotrupes silvaticus* can translate cues for light orientation into those involving orientation to gravity. His finding appears to indicate that this ability of transposing orientation cues from one sense modality to another is widespread among insects.

In a comparison of foraging honeybees and wasps on syrup dishes, Kalmus (33) reports that wasps found the dishes more quickly than bees, but unlike the bees the wasps did not alert their colony mates, and they were less constant to a particular food source.

Keenleyside & Hoar (35) tested the effects of temperature upon the responses of young salmon to water currents by placing the fish in metal wash tubs in which a constant stream of water created circular currents. Swimming against the current predominated at lower temperature but frequently turned to swimming with the current at higher temperature. One conclusion is that water temperature is not a main causative factor in salmon orientation during the seaward migration.

Time orientation was reviewed by Brown (8) in his work on the fiddler crab. Two consistent rhythms which have been worked out for the fiddler crab are (a) the animal's change of color from light to dark follows a tidal rhythm even though the animal is kept in a dark room at constant temperature, and (b) the crab's rate of oxygen consumption follows a similar rhythm. The two are believed to be tied together. They can, however, be altered. Prolonged exposure to a 32 hr. "day" of alternate darkness and light will cause the crab to assume a cycle of 96 hr.; the animals revert to a normal cycle on being replaced in a normal environment.

An experiment dealing with homing in cats was conducted by Precht & Lindenlaub (55), using a honeycomb-like labyrinth which had no blind alleys but which had 24 exits around the periphery. The authors transported cats varying distances and placed them in the center of the apparatus. Cats taken no farther from their homes than 5 km. showed a significant tendency to start off in the direction of their homes, while those transported for

distances of 12 km. or more showed only chance results. It is interesting to note that one of the conditions the authors feel they have not controlled is the extrasensory perception effect between man and cat, since the experimenter knows the proper direction. In closing, we might point out that the parapsychologists have not only shown great interest in the work of those who are doing orientation and homing experiments with animals but are now beginning to do similar studies to demonstrate that *psi* effects can take place between man and animal. While this may add to the respectability of parapsychology, it leaves some doubts as to what it will do for comparative psychology.

#### UNLEARNED ORGANIZATION OF BEHAVIOR

Extensive work in the unlearned organization of perception has been undertaken at the University of Chicago laboratories. The problem first investigated was that of chicks' natural preferences for different-colored objects. The results, reported by Hess & Gogel (26), indicate that chicks have an unlearned preference for light, desaturated colors and that these preferences cannot be explained completely by the lightness of the stimuli. Continuing this line of inquiry, Hess (25) was able to show that chicks, presented with a series of 16 colors, showed a peak of preference for Ostwald Color 4pa, a color with a maximum reflectance of 588  $m\mu$ , with a smaller peak of preference for colors 13pa and 14pa at about 470  $m\mu$ . The results for ducklings showed an entirely different preference curve with a single peak in the greenish-yellow (22pa and 24pa), which puts their preference in the region of 550  $m\mu$ . An interesting comparison between these results and those reported by Curtius (10) can be made. Working at the University of Tuebingen she used similar animals, mainly Leghorns, and six colors, red, orange, yellow, green, blue, and violet. These six colors were identical with six of those used in Hess' series. Since Curtius used a smaller number of stimuli, the preference peak in the 588  $m\mu$  region was missed. If, however, we compare her color preference plot with a plot of only the corresponding colors from Hess' larger series, we find an astonishing agreement, which is all the more gratifying when we consider that the experiments were done independently and with entirely different methods of procedure.

Within this same research program are two other studies. Fantz (11) investigated the unlearned perceptual organization of chicks in terms of natural preferences for form and pattern. He found an innate preference for spheres and ellipsoids over pyramids and stars. Decreasing preference for objects ranging from eight-sided to four-sided figures was shown, as well as preference for round over angular forms.

In an attempt to get at the chick's unlearned preference for the visual properties of water, Rheingold (58) exposed naive chicks to a series of six stimuli which were mercury, plastic, blue water, water, metal, and red water and found preferences in this descending order. The results show that bright-



ness of the reflecting surface plus movement may be a stronger releasing stimulus situation than that presented by water. A further attempt is being made to determine more accurately the parameters of this built-in preference.

Schleidt (61) analyzed the factors influencing the instinctive act of gobbling in the turkey. The effective sign stimuli are reported to be tones, sounds, and noises containing frequencies of between 200 and 6000 c.p.s. Schleidt says that apparently the innate releasing mechanism for gobbling is everything the turkey can hear which, because of a certain sound intensity, contrasts with background noises. A comprehensive analysis of innate motor patterns in the behavior of *Tylopoda* has been made by Pilters (52). The animals she studied were guanaco, llama, vicuna, alpaca, and camel, as well as hybrids of some of these. The behavior patterns studied were suckling, social behavior, social order, sexual behavior, play behavior, and maternal behavior. Particularly interesting is the account of hybrids between animals which do and those which do not evidence a particular facet of behavior.

#### GENETICS AND HOARDING

The genetic study of behavior is so recent that adequate methods of research are still in the process of formulation. The limited advance in this important area is attributable not only to the inherent difficulty of fitting minute differences in behavior to equally minute chromosomal make-up but also to the geneticist's lack of interest in behavior and the psychologist's lack of training in genetics.

Most of the psychological studies of genetic differences have accomplished nothing more than to prove behavioral differences between various inbred strains. Only by the grace of our ignorance can these studies be called genetic, since the gene mechanisms underlying the behavioral differences have not been found. An exception to this limitation is the reported work of Scott on a colony of dogs at the Jackson Memorial Laboratory. Scott (62) has recently reviewed much of his work and methods on the behavior of the dog as affected by selection and domestication. His data indicate that the multiple factor hypothesis is more reasonable to assume than simple inheritance in the determination of behavioral traits. Several pure breeds have been tested. The conclusion is reached that the exaggeration of a behavioral trait by selection may make a particular learning process easier, but it may also limit the animal's adaptability under other circumstances. Further, particular methods of achieving a goal which are presumably genetically influenced may not be additive in terms of adaptation. A somewhat humorous example will illustrate this point. Basenji puppies tend to obtain food from under a dish by pawing the cover, while the tendency of Cocker Spaniel puppies is to lift the cover with their teeth. A cross between the two breeds produces pups which are intermediate in this respect, that is, they try to paw

the cover and lift it with their teeth at the same time. The result of the competing tendencies is failure.

In another paper Scott & Charles (63) have shown how small genetic differences in behavior may be magnified by habit formation. This method places young pups of different breeds in the same social situation. The test situation was for the puppies to stand still while being weighed. The mild manual control by the experimenter was such that either passivity, escape behavior, or playful aggression was possible as an adjustment. The behavior of naive animals is usually variable, but if inherited tendencies are present, habit formation should fix the most frequent response. The use of this method on four different breeds produced the following results; Cocker Spaniels are at first significantly different from three other breeds but tend to become increasingly quiet, probably indicating an inherited susceptibility to social training; the majority of Wire Hair Terriers become increasingly active; the Basenjis show approximately equal numbers of animals which tend to become active or quiet; and the Beagles show little change, indicating that they are little affected by training. Scott suggests that hereditary differences in behavior of the higher animals tend to cause individuals to choose one of several modes of behavior with greater frequency than others, this tendency becoming consistent with habit formation under certain conditions. Thus identically treated animals may show smaller and less consistent differences before than after training.

Fredericson & Birnbaum (14) have shown differences in conflict behavior over a single loose pellet of food between the C57 and C strains of mice. The C mice will share the pellet while the C57 mice will fight over the food. The former however, can be trained to fight with the latter for a piece of food. Interestingly, the C mice trained in competition with C57 mice will not fight with inexperienced members of their own strain but will share the food.

This year's reports on hoarding behavior in rats cut across the lines of genetically and physiologically influenced changes. One paper by Stamm (70) concerns hoarding differences between three homozygous strains of rats: the black-hooded nonagouti, the brown-hooded agouti, and an Irish agouti line. The black-hooded strain began hoarding significantly sooner than the other lines. When normal conditions were restored by keeping food pellets in the rats' cages at all times the brown-hooded and Irish strains ceased hoarding after four days but the black-hooded line collected an average of five pellets for twelve days. The hoarding performance of the black-hooded animals seems so distinctly different that a more thorough investigation should reveal something of the genetic factors involved.

In another paper by Stamm (69), it is pointed out that past investigations of the effects of cortical lesions on behavior patterns have not indicated specific explorations of the median cortical surface, which is difficult to investigate since it is located along the sagittal sinus of the brain. By cauterization of the sagittal sinus to prevent fatal bleeding, Stamm was able to test

the control of the median cerebral cortex on hoarding behavior. Two groups of rats were used, one group with lateral lesions, the other group with median lesions. The preoperative mean hoarding score was 35.8 and the postoperative mean hoarding score was 33.6 for the group with lateral lesions. For the group with median lesions, however, the pre- and postoperative mean hoarding scores were 34.3 and 8.65. The difference between preoperative and postoperative scores for the latter group was significant beyond the .01 level of significance.

Gross & Cohn (21) studied the effect of vitamin B deficiency on hoarding and found that vitamin B deprived rats would hoard significantly more normal than deficient pellets. The preference disappeared when the animals were returned to a normal diet.

An experiment by Ginsburg & Fuller (19) has compared the alleviative effects of glutamic acid and interrupted sound stimulation on audiogenic seizures on an inbred line of mice. Both treatments lower the susceptibility to seizure, but glutamic acid treatment seems to give better recovery effects.

Holland (31) divided 18 albino rats into two groups, giving one group hoarding experience in the hoarding alleys for 30 min. sessions for 20 days and giving the other group experience in the alley without food and thus no opportunity to practice hoarding. On later tests, the experienced group, after food deprivation, hoarded a significantly greater number of pellets than did the no-experience group with similar deprivation schedules. The author takes this to indicate that learning has an important role in hoarding behavior.

#### SOCIAL BEHAVIOR

The British papers this year have been preponderantly concerned with the innately determined social behavior of birds, a disposition which perhaps reflects the professional standing of ornithologists among animal behaviorists in that part of the world.

Armstrong (3) and Skutch (68) have independently discussed the distraction displays given by nesting birds to lure away intruders. Both writers are agreed that the phenomenon is more to be found in noncolonial birds with nests vulnerable to ground predators, and Skutch adds as his opinion that the modes of distraction suggest great discrimination and the intelligent adaptation of an essentially innate pattern to fluctuating circumstances.

The reproductive behavior of three species of finch has been carefully delineated in respect to such stereotyped behavior patterns as aggression, appeasement, sexual activity, and displacement activities. Moynihan & Hall (47) have reported on the behavior of the Spice Finch, while Hinde (27) and Morris (46) have studied the Greenfinch and the Zebra Finch, respectively. Wood-Gush (79), using a similar method of analysis, reports that he found nine distinct behavior patterns in the courting behavior of the domestic cock.

Simmons (66) has issued a preliminary report on the advertising behavior of the Great Crested Grebe which he thinks is sexual in origin, while an American group led by Frings (16) found that a broadcast recording of a herring gull's alarm call is successful in clearing an area of gulls for anywhere from 15 min. to several hours and, conversely, a broadcast of the bird's food-finding call can be used to lure the gulls away with about the same speed as they can be driven away.

The social behavior of the honeybee has been investigated in two contexts. Free (15) has considered the behavior of robber honeybees and learned that their characteristic swaying flight in the vicinity of the hive to be robbed occurs as an innate response to the presence of a congestion of bees, of the robber's own or another colony, at the entrance of the hive being robbed. On the basis of experimentation, Kalmus (34) concluded that the clustering of honeybees around a food source was a social activity. Clustering was pronounced even when a number of identical food sources were in the same area. Fighting and agitated searching invariably occurred when five or more bees were present at the same food site. A transparent food dish with a mirror under it would facilitate clustering, and bee-like figures cut from colored paper were even more effective as a lure. Larger models were more effective than the normal size, recalling the supernormal stimuli of Tinbergen, and darker models were more preferred than lighter models.

The River Bullhead is one of the three common species of fresh water fish in Britain which construct nests and rear their young. But unlike the two species of Stickleback, the Bullhead's habits were relatively ignored until lately. Now, Morris (45) has carried out observations in the laboratory using aquarium tanks with a substratum of sand and gravel. After constructing its nest in a crevice, the male spends most of its mating time inside the nest with its head at the entrance. Whatever moves nearby is summarily bitten, and then handled in its proper context when it turns out to be food, a rival, or a female.

One other study on the behavior of fish falls into the category of social behavior, that of Allee & Dickinson (1) on dominance and subordination in the Smooth Dogfish. Dominance-subordination hierarchies have already been described for all classes of modern vertebrates except the Amphibia, Chondrichthyes, and Agnatha. Social dominance orders are well developed in various species of bony fish, which might suggest, as the authors say, a similar social structure in the cartilaginous fishes. However, the only evidence of social dominance in the Smooth Dogfish was the tendency of smaller fish to turn aside when meeting larger fish during the course of normal swimming. Food deprivation was seen to produce no demonstrable social dominance of any kind.

Another study by Anthony (2) on a laboratory colony of prairie dogs showed a dominance order to be very much in evidence. Lower ranking dogs were found to respond to the grooming approach by rolling on their backs

and exposing the abdomen in a behavior reminiscent of that found in other mammals where the exposure of a vital part of the body is construed as surrender and subordination to the despot.

Dominance hierarchies are known to be established in primates on the basis of primacy in food-getting, aggression, and sexual behavior. Rosvold, Mirsky & Pribram (59) altered an established hierarchy of eight young male rhesus monkeys by subjecting the three most dominant animals in the group situation to bilateral amygdectomy. The result was that in the group situation the two most aggressive animals fell to the bottom positions in the dominance hierarchy while the third animal moved to the top; in individual cage situations all three operative animals appeared more aggressive than usual. The authors consider it probable that one or more of the discrete structures in the temporal lobe are critical in altering patterns of aggression, a suggestion which, in its emphasis on discrete structures involved in emotion, is supplementary to previous results obtained by Bard on dogs and Klüver on monkeys.

Mahut (41) studied 101 dogs of 10 different breeds in private homes and showed a statistical difference between breeds in their reactions to five objects presumed to evoke emotional behavior.

To test closed social groups among dogs, King (36) used males and females (not in estrus) of the breeds Cocker Spaniel and Basenji. The Basenji males were shown to have a more distinct social hierarchy than females, with greater aggression toward strangers introduced to them. The rejection of strangers by the group depended largely upon the rigidity of the social structure, both in effectiveness and amount of aggression engendered.

Lehrman (39) has published results of experiments which are, in their interpretations at least, rather contrary to the ethological results of parental behavior investigations. One experiment is concerned with the parental feeding behavior of ring doves and the role of prolactin in the regurgitation of cropmilk. Lehrman found that, if they were injected with prolactin, doves with past breeding experience would feed young squabs not theirs, but that doves without past breeding experience would not do so. In a further experiment, two groups of birds with breeding experience were injected with prolactin and then one group injected in the crop with efocaine, an anesthetic, and the other group so injected elsewhere in the body. The crop-anesthetized birds fed squabs less often than the other group. Lehrman interprets his results as suggesting that prolactin is effective on a nonsitting dove only if the animal has had past experience in feeding squabs and that the prolactin elicits the feeding response by action on the crop rather than on a brain center. In addition, the regurgitation is presumed to become conditioned to visual and auditory stimuli after the initial stage of response to tactual stimulation alone. The crop-engorgement is thought to act as a drive stimulus, with the dove thereby learning to respond to the sight or sound of the squab.

In view of the many innate behavior patterns shown to be operative in social situations, some of which have been discussed in this section, it seems pertinent to make a passing reference to a paper by Verplanck (75). Despite the interest which the paper has in its own right, for Verplanck carefully enumerates some of the pitfalls both ethologists and learning theorists are prone to favor, there is an alternative position to the one Verplanck suggests. It is not necessary for psychologists to reconcile the different approaches taken by those interested in innate behavior and those interested in learned behavior by considering the two approaches not really separable nor worthy of distinction. On the contrary, it would better profit psychologists to continue to show what behavior patterns in an animal are learned and which are not. This would be a reconciliation of fact rather than a reconciliation of emotional approach. It is not necessary to say which is the more important.

#### EFFECTS OF EARLY EXPERIENCE

There has been a gratifying increase in the number of studies reported in that general research area dealing with the effects of early experience on the behavior of animals. The timely review of the literature by Beach & Jaynes (5) has brought together a large number of studies which bear on the problem. The areas covered are effects dealing with sensory perception and discrimination, feeding behavior (including hoarding), reproductive behavior, gregarious and filial behavior, emotion and temperament, and learning. Like Beach & Jaynes we will use the term experience in this section in a very broad sense.

A series of papers have appeared which deal with attempts to restrict the early sensory or perceptual experience of animals or otherwise to deprive young animals. Melzack (43) observed that pups raised in a restricted perceptual environment showed a predominance of diffuse emotional excitement to test objects which control dogs tended to avoid. Ten to 12 months after release there was no difference between the two groups in making avoidance responses, but the restricted dogs continued to show diffuse emotional excitement while the free environment dogs now displayed aggression responses. Dogs restricted in early life were shown by Thompson & Heron (72) to be more active than normal animals. The most severely restricted were the most active when measured in terms of "exploratory" behavior. In another study (73), the same experimenters raised 13 dogs for the first 7 to 10 months in a restricted perceptual situation. Complete isolation to semi-isolation was used, and the findings indicate that restricted animals are on the average inferior to control animals in the delayed reaction test and in open field mazes. Forgas (13) studied the effect of different experiential conditions in rats and concluded that early experience and learning are important determinants of the emotionality and cognitive ability of adult rats. He further concluded that the quality of the animals' infant experiences will determine the kinds and number of "hypotheses" they can test when solving a problem



at adulthood. In another paper, using a similar procedure, Luchins & Forgas (40) conclude that a narrow experiential background makes the organism more susceptible to the binding effects of habit. Hess & Gogel (26), in an attempt to modify preferences of the chick for objects of different colors, took chicks from a dark incubator, dyed them a blue-green and then kept them in a blue-green environment. In another case chicks were taken from incubators, placed in an environment in which the only illumination was through a green filter. In both these instances, no change in preference for colored objects was found, as compared with control animals.

Baker (4) studied the relation between length of food deprivation and food consumption. In a longitudinal study using albino rats, he found that for the first 10 days there was a relatively slow adaptation to the deprivation schedule. A perfect negative correlation between length of deprivation and food consumption was found. Baker suggests that any direct relation between the length of deprivation interval and feeding behavior is largely the result of previously having established a definite feeding rhythm.

The hypothesis that an animal's early social experience affects his social behavior as an adult was tested by King & Gurney (37) in an experiment where three groups of C57BL/10 male mice were raised in different social conditions and then tested for fighting behavior. The authors found inferior fighting behavior in mice raised in isolation and suggest two possible explanations: that there is a latent learning of aggression through the competitive associations of mice raised in groups, or that the innate tendency for aggressiveness is inhibited in direct proportion to the strangeness of the situation. Seitz (64) raised groups of rats in which the litter was adjusted to 6 and to 12 pups. Males raised in small litters weighed more than males from larger litters, a difference which continued far into adulthood. The animals from small litters tended to eat more, hoarded less food during adulthood, reacted to novel experiences with less anxiety and more exploratory behavior. Large litter animals exhibited more mating behavior to females in estrus and were more vicious.

Two studies deal with the development of maturationally determined processes in birds. Sauer (60) reared Whitethroats (*Sylvia c. communis*) in isolation in soundproof rooms where they had been hatched from artificially incubated eggs. Comparison of these animals with wild birds showed that all 25 call-notes characteristic of the species are innate. The song development of the male begins with a continuous reiteration of the same note comparable to the food calls of the fledgling. Gradually a growing number of single notes make their appearance and are integrated into the bird's song. Simon (67) investigated the development of optomotor nystagmus in chicks reared normally and in chicks reared in darkness. As a coordinated movement the rhythmic optomotor nystagmus is innate. The frequency and angular velocity, however, are dependent upon age and experience factors. Of particular interest is her finding that accuracy of pursuit is attained by animals reared



up to 12 days in optic isolation, although such pursuit comes into play only later in the chicks' maturational development and only after normal visual experience.

While previous accounts [Beach & Jaynes (5)] in the literature have indicated that the establishment of the following-response is possible only during the first 24 hr. in some waterfowl, Ramsay & Hess (56) have recently shown that the critical age for such "imprinting" can be extended by the use of social facilitation. By using techniques which would allow a quantitative evaluation of imprinting strength, they were also able to show that the optimal age for imprinting in mallards as well as in other ground nesting birds lies between 12 and 17 hr. after hatching. The actual exposure time to the model on which the young birds were imprinted was 10 min. A continuation of this work (24) indicates that the maximum sensitivity for imprinting in the mallard is about 16 hr. after hatching. Additional experiments showed that it is not the time during which the animal is exposed to the object but rather the amount of effort expended in order to get to or keep up with that object which determines the strength of imprinting.

## LITERATURE CITED

1. Allee, W. C., and Dickinson, J. C., Jr., "Dominance and Subordination in the Smooth Dogfish *Mustelus canis* (Mitchell)," *Physiol. Zool.*, **27**, 356-64 (1954)
2. Anthony, A., "Behavior Patterns in a Laboratory Colony of Prairie Dogs, *Cynomys ludovicianus*," *J. Mammalogy*, **36**, 69-78 (1955)
3. Armstrong, E. A., "The Ecology of Distraction Displays," *Brit. J. Animal Behaviour*, **2**, 121-35 (1954)
4. Baker, R. A., "The Effects of Repeated Deprivation Experience on Feeding Behavior," *J. Comp. Physiol. Psychol.*, **48**, 37-42 (1955)
5. Beach, F. A., and Jaynes, J., "Effects of Early Experience upon the Behavior of Animals," *Psychol. Bull.*, **51**, 239-63 (1954)
6. Birukow, G., "Photo-geomenotaxis bei *Geotrupes silvaticus* Panz. und ihre Zentralnervöse Koordination," *Z. vergleich. Physiol.*, **36**, 176-211 (1954)
7. Brady, J. V., in *Experimental Psychopathology* (In press)
8. Brown, F. A., "Biological Clocks and the Fiddler Crab," *Sci. American*, **190**, 34-37 (1954)
9. Butler, R. A., and Harlow, H. F., "Persistence of Visual Exploration in Monkeys," *J. Comp. Physiol. Psychol.*, **47**, 258-63 (1954)
10. Curtius, A., "Über Angeborene Verhaltensweisen bei Vögeln, Insbesondere bei Hühnerküken," *Z. Tierpsychol.*, **11**, 94-109 (1954)
11. Fantz, R. L., "Object Preferences and Pattern Vision in Newly Hatched Chicks" (Doctoral thesis, Univ. of Chicago, Chicago, Ill., 1954)
12. Fink, H. K., *Mind and Performance: A Comparative Study of Learning in Mammals, Birds, and Reptiles* (Vantage Press, New York, N. Y., 113 pp., 1954)
13. Forgas, R. H., "The Effect of Early Perceptual Learning on the Behavioral Organization of Adult Rats," *J. Comp. Physiol. Psychol.*, **47**, 331-36 (1954)
14. Fredericson, E., and Birnbaum, E. A., "Competitive Fighting between Mice with Different Hereditary Backgrounds," *J. Genet. Psychol.*, **85**, 271-80 (1954)
15. Free, J. B., "The Behaviour of Robber Honeybees," *Behaviour*, **7**, 232-40 (1954)
16. Frings, H., Frings, M., Cox, B., and Peissner, L., "Recorded Calls of Herring Gulls (*Larus argentatus*) as Repellents and Attractants," *Science*, **121**, 340-41 (1955)
17. Frisch, K. von, *The Dancing Bees* (Harcourt, Brace & Company, New York, N. Y., 183 pp., 1955)
18. Frisch, K. von, and Lindauer, M., "Himmel und Erde in Konkurrenz bei der Orientierung der Bienen," *Naturwissenschaften*, **41**, 245-53 (1954)
19. Ginsburg, B. E., and Fuller, J. L., "A Comparison of Chemical and Mechanical Alterations of Seizure Patterns in Mice," *J. Comp. Physiol. Psychol.*, **47**, 344-48 (1954)
20. Green, G. W., "Some Laboratory Investigations of the Light Reactions of the Larvae of *Neodiprion americanus banksianae* Roh. and *N. lecontei* (Fitch) (Hymenoptera: Diprionidae)," *Can. Entomologist*, **86**, 207-22 (1954)
21. Gross, N. B., and Cohn, V. H., "The Effect of Vitamin-B Deficiency on the Hoarding Behavior of Rats," *Am. J. Psychol.*, **47**, 124-28 (1954)
22. Gunter, R., "The Discrimination between Lights of Different Wave Lengths in the Cat," *J. Comp. Physiol. Psychol.*, **47**, 169-72 (1954)
23. Harlow, H. F., and McClearn, G. E., "Object Discrimination Learned by Monkeys on the Basis of Manipulation Motives," *J. Comp. Physiol. Psychol.*, **47**, 73-82 (1954)

24. Hess, E. H., "Experimental Analysis of Imprinting" (In preparation)
25. Hess, E. H., "Natural Preferences of Chicks and Ducklings for Objects of Different Colors" (In preparation)
26. Hess, E. H., and Gogel, W. C., "Natural Preferences of the Chick for Objects of Different Colors," *J. Psychol.*, **38**, 483-93 (1954)
27. Hinde, R. A., "The Courtship and Copulation of the Greenfinch (*Chloris chloris*), *Behaviour*, **7**, 207-32 (1954)
28. Hoffmann, K., "Die Einrechnung der Sonnenwanderung bei der Richtungsweisung des Sonnenlos Aufgezogenen Stares," *Naturwissenschaften*, **40**, 148 (1953)
29. Hoffmann, K., "Experimentelle Änderung des Richtungsfindens beim Star durch Beeinflussung der 'inneren Uhr'," *Naturwissenschaften*, **40**, 608-9 (1953)
30. Hoffmann, K., "Versuche zu der im Richtungsfinden der Vögel enthaltenen Zeitschätzung," *Z. Tierpsychol.*, **11**, 453-75 (1954)
31. Holland, J. G., "The Influence of Previous Experience and Residual Effects of Deprivation on Hoarding in the Rat," *J. Comp. Physiol. Psychol.*, **47**, 244-47 (1954)
32. Jones, L. V., "Distinctiveness of Color, Form, and Position Cues for Pigeons," *J. Comp. Physiol. Psychol.*, **47**, 253-57 (1954)
33. Kalmus, H., "Finding and Exploitation of Dishes of Syrup by Bees and Wasps," *Brit. J. Animal Behaviour*, **2**, 136-43 (1954)
34. Kalmus, H., "The Clustering of Honeybees at a Food Source," *Brit. J. Animal Behaviour*, **2**, 63-72 (1954)
35. Keenleyside, M. H. A., and Hoar, W. S., "Effects of Temperature on the Responses of Young Salmon to Water Currents," *Behaviour*, **7**, 77-87 (1954)
36. King, J. A., "Closed Social Groups among Domestic Dogs," *Proc. Am. Phil. Soc.*, **98**, 327-36 (1954)
37. King, J. A., and Gurney, N. L., "Effects of Early Social Experience on Adult Aggressive Behavior in C57BL/10 Mice," *J. Comp. Physiol. Psychol.*, **47**, 326-30 (1954)
38. Lehrman, D. S., "A Critique of Konrad Lorenz's Theory of Instinctive Behavior," *Quart. Rev. Biol.*, **28**, 337-63 (1953)
39. Lehrman, D. S., "The Physiological Basis of Parental Feeding Behavior in the Ring Dove (*Streptopelia risoria*)," *Behaviour*, **7**, 241-86 (1955)
40. Luchins, A. S., and Forgas, R. H., "The Effect of Differential Post-Weaning Environment on the Rigidity of an Animal's Behavior," *J. Genet. Psychol.*, **86**, 51-58 (1955)
41. Mahut, H., "Breed Differences in the Dog's Emotional Behavior," *Am. Psychologist*, **9**, 425 (1954)
42. Matthews, G. V. T., "An Investigation of the 'Chronometer' Factor in Bird Navigation," *J. Exptl. Biol.*, **32**, 39-58 (1955)
43. Melzack, R., "The Genesis of Emotional Behavior: An Experimental Study of the Dog," *J. Comp. Physiol. Psychol.*, **47**, 166-68 (1954)
44. Meyer, D. R., "Comparative Psychology," *Ann. Rev. Psychol.*, **6**, 251-66 (1955)
45. Morris, D., "The Reproductive Behaviour of the River Bullhead (*Cottres gobio* L.), with Special Reference to the Fanning Activity," *Behaviour*, **7**, 1-32 (1954)
46. Morris, D., "The Reproductive Behaviour of the Zebra Finch (*Poephila guttata*), with Special Reference to Pseudofemale Behaviour and Displacement Activities," *Behaviour*, **6**, 271-322 (1954)

47. Moynihan, M., and Hall, M. F., "Hostile, Sexual, and Other Social Behavior Patterns of the Spice Finch (*Lonchura punctulata*) in Captivity," *Behaviour*, **7**, 33-76 (1954)
48. Newth, D. R., and Ross, D. M., "On the Reaction to Light of *Myxine glutinosa* L.," *J. Exptl. Biol.*, **32**, 4-21 (1955)
49. Pardi, L., "Über die Orientierung von *Tylos latreillii* Aud. & Sav. (*Isopoda terrestria*)," *Z. Tierpsychol.*, **11**, 175-81 (1954)
50. Pastore, N., "Discrimination Learning in the Canary," *J. Comp. Physiol. Psychol.*, **47**, 389-90 (1954)
51. Pastore, N., "Spatial Learning in the Canary," *J. Comp. Physiol. Psychol.*, **47**, 288-89 (1954)
52. Pilters, H., "Untersuchungen über Angeborene Verhaltensweisen bei Tylopoden, unter Besonderer Berücksichtigung der Neuweltlichen Formen," *Z. Tierpsychol.*, **11**, 213-303 (1954)
53. Pratt, J. G., "An Investigation of Homing Ability in Pigeons without Previous Homing Experience," *J. Exptl. Biol.*, **32**, 70-83 (1955)
54. Pratt, J. G., and Thoules, R. H., "Homing Orientation in Pigeons in Relation to Opportunity to Observe the Sun before Release," *J. Exptl. Biol.*, **32**, 140-57 (1955)
55. Precht, H., and Lindenlaub, E., "Über das Heimfindevermögen von Säugetieren. I. Versuche an Katzen," *Z. Tierpsychol.*, **11**, 485-94 (1954)
56. Ramsay, A. O., and Hess, E. H., "A Laboratory Approach to the Study of Imprinting," *Wilson Bull.*, **66**, 196-206 (1954)
57. Rawson, K. S., "Sun Compass Orientation and Endogenous Activity Rhythms of the Starling (*Sturnus vulgaris* L.)," *Z. Tierpsychol.*, **11**, 446-52 (1954)
58. Rheingold, H., "The Chick's Unlearned Preference for some Visual Properties of Water" (In preparation)
59. Rosvold, H. E., Mirsky, A. F., and Pribram, K. H., "Influence of Amygdectomy on Social Behavior in Monkeys," *J. Comp. Physiol. Psychol.*, **47**, 173-78 (1954)
60. Sauer, F., "Die Entwicklung der Lautäußerungen vom Ei ab Schalllicht Gehaltener Dorngrasmücken (*Sylvia c. communis*, Latham) im Vergleich mit Später Isolierten und mit Wildlebenden Artgenossen," *Z. Tierpsychol.*, **11**, 10-93 (1954)
61. Schleidt, M., "Untersuchungen über die Auslösung des Kollerns beim Truthahn (*Meleagris gallopavo*)," *Z. Tierpsychol.*, **11**, 417-35 (1954)
62. Scott, J. P., "The Effects of Selection and Domestication upon the Behavior of the Dog," *J. Natl. Cancer Inst.*, **15**, 739-58 (1954)
63. Scott, J. P., and Charles, M. S., "Genetic Differences in the Behavior of Dogs: A Case of Magnification by Thresholds and by Habit Formation," *J. Genet. Psychol.*, **84**, 175-88 (1954)
64. Seitz, P. F. D., "The Effects of Infantile Experiences upon Adult Behavior in Animal Subjects: I. Effects of Litter Size during Infancy upon Adult Behavior in the Rat," *Am. J. Psychiat.*, **110**, 916-27 (1954)
65. Sidman, M., and Stebbins, W. C., "Satiation Effects under Fixed-Ratio Schedules of Reinforcement," *J. Comp. Physiol. Psychol.*, **47**, 114-16 (1954)
66. Simmons, K. E. L., "The Advertising Behavior of the Great Crested Grebe," *Bird Study*, **1**, 53-56 (1954)
67. Simon, M. E., "Der Optomotorische Nystagmus während der Entwicklung

- Normaler und Optisch Isoliert Aufgewachsener Küken," *Z. Vergleich. Physiol.*, **37**, 82-105 (1954)
68. Skutch, A. F., "The Parental Stratagems of Birds," *Ibis*, **96**, 544-64 (1954); **97**, 118-42 (1955)
69. Stamm, J. S., "Control of Hoarding Activity in Rats by the Median Cerebral Cortex," *J. Comp. Physiol. Psychol.*, **47**, 21-27 (1954)
70. Stamm, J. S., "Genetics of Hoarding: I. Hoarding Differences between Homozygous Strains of Rats," *J. Comp. Physiol. Psychol.*, **47**, 157-61 (1954)
71. Steven, D. M., "Experiments on the Light Sense of the Hag, *Myxine Glutinosa* L.," *J. Exptl. Biol.*, **32**, 22-38 (1955)
72. Thompson, W. R., and Heron, W., "The Effects of Early Restriction on Activity in Dogs," *J. Comp. Physiol. Psychol.*, **47**, 77-82 (1954)
73. Thompson, W. R., and Heron, W., "The Effects of Restricting Early Experience on the Problem-Solving Capacity of Dogs," *Can. J. Psychol.*, **8**, 17-31 (1954)
74. Towe, A. L., "A Study of Figural Equivalence in the Pigeon," *J. Comp. Physiol. Psychol.*, **47**, 283-87 (1955)
75. Verplanck, W. S., "Since Learned Behavior is Innate and Vice Versa, What Now?," *Psychol. Rev.*, **62**, 139-44 (1955)
76. Vowles, D. M., "The Orientation of Ants. I. The Substitution of Stimuli," *J. Exptl. Biol.*, **31**, 341-55 (1954)
77. Vowles, D. M., "The Orientation of Ants. II. Orientation to Light, Gravity and Polarized Light," *J. Exptl. Biol.*, **31**, 356-75 (1954)
78. Wellington, W. G., Sullivan, C. R., and Henson, W. R., "The Light Reactions of Larvae of the Spotless Fall Webworm *Hyphantria textor* Harr (Lepidoptera: Arctiidae)," *Can. Entomologist*, **86**, 529-42 (1954)
79. Wood-Gush, D. G. M., "The Courtship of the Brown Leghorn Cock," *Brit. J. Animal Behaviour*, **2**, 95-102 (1954)

## PHYSIOLOGICAL PSYCHOLOGY<sup>1,2</sup>

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In an annual review of a subject as broad as physiological psychology it is difficult to confine oneself to specific studies which have occurred during that year only. Reference to a wide variety of studies in relative isolation and out of proper temporal context serves little purpose other than a cataloguing value. Any reader interested in a highly specific branch of the subject, for teaching or research purposes, would have little difficulty in searching the literature for that year with regard to such a topic.

My plan is to concentrate mainly upon four areas of recent advance in neurophysiology, in which either very significant research progress has been made or in which the application of new techniques or the investigation of new problems seems to hold significant promise for psychology in general and for physiological psychology in particular. Before doing this, I should like to make a few general observations and introduce two very important, new books which provide a background for at least three of the four topics I will attempt to review.

Physiological psychology is in a potentially enviable position, providing its adherents can be aroused from a kind of lethargy and complacency akin to smugness, and providing they can do a balancing act on a slack rope. The balancing act requires that they retain an anchoring in things psychological, while at the same time they attempt to gain a requisite background in things anatomical and physiological, with special emphasis on neurophysiology and neuroanatomy. Their strategic interdisciplinary position between psychology and physiology places upon them a great responsibility not only for liaison, but for integrative effort. The relevance and importance of this statement is not new but has been pointed up especially by some of the developments during the year of this review. One of these, which takes the form of a recognition of need for interdisciplinary interaction and co-operation, was the foresight on the part of someone who will go unnamed, and the wisdom and generosity of the Carnegie Corporation of New York whose grant to the National Research Council will make possible some postdoctoral fellowships for interdisciplinary training.

Young psychologists with a few postdoctoral years of experience in physiological or comparative psychology will have opportunity to broaden their background in research centers for neurophysiology. Similarly, opportunity will be provided for young neurophysiologists to work with psychologists,

<sup>1</sup> The survey of the literature pertaining to this review was completed in July 1955.

<sup>2</sup> The following abbreviations have been used in this chapter: EEG (electroencephalogram); C.N.S. (central nervous system).

from whom they may learn something of the methods and procedures of behavioral study, and become better acquainted with problems of psychological nature. Although some interaction of this kind has been going on slowly and informally for some time, the formalization and activation of a fellowship program of this nature is particularly timely.

In an earlier review (1) and in a vice-presidential address at the 1954 meeting of the American Association for the Advancement of Science (1a) the author called attention to the extensive and rapid progress of neurophysiology and the need for psychologists to keep abreast of some of these developments. At the same time it was emphasized that there is a need for interdependence, since the methods of neither psychology nor physiology alone will suffice to answer the question of how a world of changing stimulus parameters can account for the development and maintenance of a dynamically ordered economy of behavioral response and adjustment.

The story of receptor-transducers and their mechanism for transforming stimulus characteristics into nerve messages, neural conductors for transmitting messages, and the matrix of central integrators for coding, decoding, elaborating, and storing of data is an exciting and stimulating one as it is gradually being revealed by electrophysiology and associated neurophysiological procedures. Yet it is not enough to trace the origin and course of nerve impulses from stimulus to response, nor to determine the methods of coding and decoding messages, nor even to discover the so-called neural correlates of behavior. The meaning and understanding of the process of behavior will be achieved only when there is a coalescence of process and mechanism. The data of neurophysiology, however valuable and revealing, will still require the methods of psychology, ranging from psychophysics on the one hand to behavioral analysis on the other, in order to make meaningful the stimulus-response integrations of total, complex organisms.

Perhaps the best evidence for such a statement is to be found in two outstanding books which appeared during the period of this review. The first of these is a compilation of papers presented at The Laurentian Symposium in August of 1953 and published in book form in 1954 under the title, *Brain Mechanisms and Consciousness* (2). An excellent side-line report on some of the details of this symposium has been presented by Brazier (3) who was one of the participants. Therefore, a review of each of these important papers will not be given here, although further reference will be made to the book and some of the individual presentations. Suffice it to say that 20 eminent neurophysiologists, neuroanatomists, neuropsychologists, and neuropsychiatrists from eight different countries participated: Adrian, Brazier, Bremer, Fessard, Gastaut, Hebb, Hess, Jasper, Jung, Kubie, Lashley, Magoun, Morison, Moruzzi, Nauta, Olszewski, Penfield, Rioch, Walter, and Whitlock.

The second book is Granit's (4) *Receptors and Sensory Perception*, which is comprised of his Silliman Lectures delivered at Yale University in 1954. If it may be said that Adrian's *The Basis of Sensation* was the original stepping-stone from a sensory psychology based on psychophysics to a new world



of investigation in electrophysiology, and his *The Mechanism of Nervous Action* a further demonstration of the power of an electronic age in the linking of neurophysiology with behavior, then it may also be said that this most recent book of Granit's is a long overdue but welcome and challenging extension of the methods of neurophysiology, and particularly electrophysiology, into the area of sensory reception and, to a lesser extent, the field of perception. As Chang's review (5) so ably put it,

Not . . . since 1928 when Adrian's *The basis of sensation* was published have the action of sense organs and the process of sensation been described and discussed so adequately and comprehensively in strict terms of nerve impulses as in Professor Granit's recent volume, *Receptors and sensory perception*. . . . Although the main theme is limited to receptors and perception, the problems discussed in the book encompass practically the whole field of neurophysiology ranging from the mechanism of nerve impulse initiation to the sensory representation in the cerebral cortex.

Granit, though concentrating heavily upon new data in the field of vision which have appeared since the 1947 publication of his classic *Sensory Mechanisms of the Retina* (6), deals also with an area of research which has occupied his interest for several years, namely, the muscle receptors and their reflexes. In the visual sphere he presents new information bearing on his dominator-modulator theory and attempts to show how photochemical data parallel and substantiate electrophysiological data. He also discusses new results revealed by the electroretinogram, mostly data uncovered by colleagues or former associates.

Granit brings up to date his latest concepts of receptor function, dealing especially with the basic primary receptor processes, the generator potential, which he believes initiates the discharge of nerve impulses. He cites the work of Alvarez-Buylla & Ramirez de Arellano (7) and of Gray & Sato (8) on generator potentials in the Pacini body and the work of Davis, Tasaki & Goldstein (9), Tasaki & Fernández (10), and von Békésy (11) for the auditory receptors. He draws the conclusion that the cochlear microphonics, a result of mechanical deformation of hair-cells, constitute generator potentials giving rise to auditory nerve discharge. He presents other evidence on the origin of afferent discharge in the muscle spindle (12, 13) and in visual receptors (14, 15).

Two other principles of reception with which he deals are receptive fields, and their functional and anatomical significance for sensory discrimination, and, coupled with this, the organization of a frequency code, which is believed to play the major role in sensory discrimination and integration of incoming messages. This latter is concerned with the rate and patterning of nerve impulse discharges which are believed to constitute important elements of a coding system, apart from, but related to, the spatial factors associated with receptive fields.

In a final chapter on discrimination and integration, there is an attempt to approach and account for some of the aspects of perception with which the psychologist must deal. Although some valuable leads are provided, this

section falls far short of its mark. In discrimination and integration, in which both receptive fields and frequency code play a role, there is a heavy dependence upon the work of Enroth (16) and Dodt & Enroth (17), dealing with the on-off response of single retinal elements studied during flicker-fusion experiments. Granit believes that Enroth's results "provide a physiological explanation of why flicker photometry is possible on the basis of the idea that impulse frequency should measure 'intensity,' which in vision has brightness for its equivalent." He further believes that the basic relation between intensity and impulse frequency is preserved by an averaging process, even though individual elements behave in a variety of ways. He also holds that the overlapping of receptor fields is part of the peripheral organization which favors the averaging process and thus allows an over-all relation between intensity (brightness) and spike-impulse frequency in optic nerve fibers.

But, apart from the intensity-frequency component of an afferent visual message, other qualities such as color and movement must also be transmitted, he believes, in a given fiber. Granit cites the work of Donner (18) as providing a basis for color discrimination in terms of the rate of rise of nerve impulse frequency, that is, the so-called frequency/time differential. The rate of rise in frequency at on and off (as well as perhaps the rate of fall) helps to provide patterns involving the frequency code which convey information about intensity, color, movement, and so forth. The work of Riggs *et al.* (19, 20) shows that the eye is in continual movement with moderately rapid small tremor movements of saccadic nature, a fact which may account for basic dynamic sensitivity of retinal elements, rather than a static adaptation. This would presumably be brought about through the on-off discharge mechanism of individual receptors or ganglion-cell families thus stimulated.

The array of important topics taken up in Granit's book is by no means exhausted at this point, and three of the four here chosen to point up for this year's review he discusses under the following headings: "specific and unspecific afferents" (discussed only briefly), "centrifugal control" (discussed mainly with reference to the retina and the gamma efferents associated with action of muscle spindles, but very detailed and complete), and "microelectrode techniques," upon which so much of his work has depended.

#### NEW CONCEPTS OF CENTRAL NERVOUS SYSTEM ORGANIZATION AND FUNCTION

The four topic areas selected for review are particularly timely for they are part of a recent general advance in neurophysiology which cannot help but increase our understanding of the mechanisms underlying psychological phenomena and behavior. These will be taken up in the following order: (a) the role and significance of specific and unspecific afferent systems, (b) feedback control or centrifugal regulation of afferent influx, (c) C.N.S. unit analysis by microelectrode methods, (d) the limbic system. These topics are not unrelated for there are many points of interaction and interrelationship, some of which will be brought out subsequently.

*Specific and unspecific afferent systems.*—The basic subject matter of The Laurentian Symposium [see *Brain Mechanisms and Consciousness* (2)], was centered around the nature and interaction of these two systems of sensory influx and control in the brain. It was first established in 1949, with the chance observation by Moruzzi & Magoun (21), that electrical stimulation of the grey masses of the lower brain stem, known as the reticular formation, gives rise to a generalized desynchronization of cortical electrical activity and the induction of some fast components in the EEG picture. These changes in the EEG were recognized as being similar to those which accompany arousal from sleep, or the alerting to or establishment of attention with the presentation of sensory stimulation or a problem-solving set, namely, a change from a picture of slow or 10 per second alpha rhythm to fast low amplitude activity.

The next steps were to localize and better define the nature of this effect, and these were undertaken in studies (22 to 25) which involved lesions of the classical afferent paths alone but left intact the tegmentum or reticular core of the midbrain region, or vice versa. With the classical or specific sensory pathways of this region destroyed, electrical stimulation of the ascending reticular system or the presentation of auditory, tactual, or pain stimuli, produced EEG activation and in chronic preparations a behavioral state of arousal or alerting if the animal was in natural sleep or wakefulness, respectively. With the classical afferent pathways intact and the central reticular core interrupted toward the rostral end of the midbrain, the animal behaviorally was characteristically in a state of somnolence or sleep from which it was difficult to arouse him except by strong stimuli which then barely and momentarily gave rise to partial arousal. Consequently, the stimulation of the reticular formation of the brain stem, whether by artificial electrical shock or by natural sensory stimulation, was capable of modifying the EEG in the direction of desynchrony and low-level fast activity, a change comparable to that seen in going from sleep or relaxation to an alert, waking state in the human. Such waking states in the human are characteristically associated with focusing the attention upon a stimulus or assuming a problem-set involving anticipation and readiness.

In a number of studies from several laboratories, the results of which have been summarized by Magoun (26, 27, 28), it now is clear that the classical sensory pathways, which have long been known, pass through the lateral regions of the lower brain stem and midbrain and relay in their respective nuclei of the thalamus, thereafter to project to specific primary receiving areas of the cortex. In the course of their passage through the lower brain stem they give off collaterals which presumably set up recurrent discharges in the tangled network of the reticular formation. Because these effects of collateral stimulation are transmitted rostrally or upward in the brain, this mechanism has become known as the ascending reticular system. Because its central effects result in cortical EEG desynchrony or "activation" and because its behavioral effects are arousal, "activation," or alerting, the gen-

eral terms "reticular activation system" or "arousal" of "alerting" mechanism have been applied.

The exact pathway of this ascending reticular system is still a matter of some debate, for there is some evidence that its influences may pass by way of the subthalamus and internal capsule, thus by-passing the thalamus. However, there is perhaps more extensive evidence that nonspecific thalamic nuclei, especially centre median and intralaminar nuclei, as well as nuclei such as the ventromedial and ventralis anterior, play a major role. Still another view is that the dorsomedial and reticular nuclei are the thalamic stations of this diffusely spreading influence.

Whereas the activity of the reticular activating system and the diffusely projecting pathways from thalamus to cortex has generally been thought of as producing rather widespread desynchrony and "activation" in the electrical activity of the various areas of the cortex, there has been some tendency to delimit its principal influence to the widespread association areas and motor cortex. More recently Jasper *et al.* (29) have shown that its effect extends also to primary sensory areas.

One feature of a number of earlier observations was that it appeared that any sensory stimulus was capable of exciting the reticular activating system, whether visual, auditory, tactual, vestibular, or what not. In other words, the reticular formation was thought of as a kind of pool into which poured impulses from all main afferent streams coursing centrally to the thalamus and cortex. It could be demonstrated that one stimulus was as good as another in evoking electrical responses in the reticular formation or in producing electrocortical activation or behavioral arousal. Although this general view of unspecificity and diffuseness of action is still true, there have recently been suggestions by Jasper (2) that thalamo-cortical projections of this nonspecific system may be more specific than originally thought; Olszewski (2) has indicated also that anatomically the reticular formation is a poorly defined structure, that anatomical and physiological conceptions of it do not correspond strictly, and finally that it is not a morphological unit but is composed of many diverse nuclei. Perhaps most recent and significant in this respect is a study by Scheibel *et al.* (30) utilizing microelectrodes in or on single neuronal units of the reticular formation where it was found that a given cellular unit might be fired by one type of sensory stimulus and not another but that in all probability many units capable of being fired by more than one sensory modality also exist. In any case a large number of units in an interlocking meshwork such as the reticular formation, even though differentially aroused by varying sensory stimuli, might still act as a diffuse and unspecific arousal mechanism for the cortex. This seems to be the case, generally speaking.

There are several other characteristics of this system which should be enumerated. As might be expected from the multisynaptic connections, centripetal messages through this unspecific sensory system have a longer latency than through the classical sensory pathways to primary receiving

zones (31). Under the influence of anesthesia (32) the responsivity of the reticular activating system and its effect upon the cortex are the first to disappear. Under barbiturates evoked potentials may still be produced in primary receiving areas of the cortex, indicating that the direct or specific sensory pathways still transmit sensory messages, but these are incapable of being discriminated and decoded. This fact raises the question as to what role the unspecific or ascending reticular activating system plays in the integration of sensory messages received at the cortex. There is at least some indication that it is a necessary influence and perhaps sets the stage for the spreading and elaboration of the effects which reach the primary receiving areas of the cortex. Its relative nonspecificity would favor this. If it acted by resetting excitability cycles of many neuronal aggregates so that a greater statistical availability of cellular units or patterns of units could at once be made possible, it should facilitate the chances of the primary message being received and transmitted in secondary or association areas and eventually leading to a response through the motor system.

Whatever the nature of its action in the cortex, it is at once clear that there is an effect as shown in the EEG and also in the behavioral changes when an arousal stimulus is applied. This stimulus may be in any sense modality and presumably may be of any supraliminal intensity. Thus it is clear that this mechanism undoubtedly plays a significant role in the sleep-waking process and that it also has a good deal to do with the process of, or state of, consciousness as exemplified under conditions of sleep, anesthesia, and coma as contrasted to waking, alert, attentive, or highly aroused and excited states. These changes which are so well known through our behavioral experiences and observations have been described by Lindsley (33) in terms of a continuum together with the EEG states which are most likely associated with them. Since so many facets of psychological interest attach to this mechanism it is perhaps not amiss to suggest as did Lindsley (34), and more recently Hebb (35), that this nonspecific, diffuse, ascending reticular activating system may well underlie the energizing aspects of emotion, motivation, and drive. It seems equally clear that it may play a very significant role in perception and learning, quite apart from its motivational possibilities, by focussing attention and by controlling the elaboration of sensory messages which have arrived at primary cortical receiving zones over direct cortical projection pathways. To what extent this influence involves coding, decoding, storage and recovery processes cannot yet be said. However, it is quite apparent that in the absence of activation by the unspecific sensory system evoked potentials still signal the arrival of sensory impulses at the cortex via the classical relay system, but these presumably do not result in discrimination or further reaction. When the reticular activating system is intact and functional, electrocortical reaction and behavioral response are possible.

Activation via the reticular activating system appears not to be limited to sensory influx into it from collaterals of classical afferents, since cortical

stimulation produces responses in the reticular formation as has been shown by Jasper *et al.* (36), Bremer & Terzuolo (37), French *et al.* (38), and most recently by Hernández-Péon & Hagbarth (39). The latter have demonstrated that afferent and corticifugal influences upon the reticular formation may interact by either interference or facilitation. Both "occlusion" and "subliminal fringe" phenomena have been demonstrated. They believe it likely that reticular unresponsiveness, attributable to interaction upon reticular neurones from two or more sources, may well influence sensory perception and awareness of consciousness.

Presumably such interaction in moderation could lead to facilitation, whereas excessive bombardment could lead to complete blocking of reticular activation upon the cortex with resulting disturbances in attention, awareness, and even complete loss of consciousness as observed in some seizure states. The kind of sudden and intense barrage from afferent and corticifugal sources in certain situations described as emotion-arousing (extreme startle and fear) could be responsible for the confusion and immobilization which often result under such circumstances. The EEG under these conditions usually shows a picture of complete and prolonged flattening or increased high-frequency activity. These two EEG conditions, also noted in certain patients with acute or chronic anxiety [Cohn (40); Lindsley (41)], could reflect excessive inhibition or facilitation in the reticular formation.

In addition to the afferent and corticifugal inflow into the multineuronal pool of the lower brain stem reticular formation, there is evidence that the cerebellum [Mollica *et al.* (42)], and rhinencephalon (amygdaloid nucleus) [Gloor (43)] can also influence this system. Bonvallet *et al.* (44) have shown, in confirmation of earlier work of Darrow *et al.* (45, 46), that spontaneous fluctuation of the electrical activity of the cortex corresponds to similar parallel changes in the level of sympathetic tone. In addition they have demonstrated that visceral and nociceptive stimuli produce marked activation of the cortex and parallel sympathetic changes.

Their analysis of these results suggests that two mechanisms are involved, one, a direct influx of such stimuli into the bulbar reticular formation with immediate cortical activation, and two, a delayed "humoral" process which acts not upon the cortex directly but instead upon the ponto-mesencephalic reticular activating system and then the cortex. This "humoral" activation permits cortical adjustment to peripheral sympathetic activity then in effect. The authors state that

The fact that the increase in sympathetic tone (adrenaline, slight hypertension) is able to produce an electrical picture of cortical activation which is indistinguishable from that produced by an exteroceptive stimulus, suggests that the level of peripheral sympathetic tone is just as important a factor in maintaining the waking state as the continuous inflow to the brain of proprioceptive and exteroceptive stimuli.

These authors have also demonstrated that distention of the carotid sinus under experimental control which prevents reduction of blood pressure and



vasomotor control of cerebral circulation is capable of inhibiting by nervous transmission the brain stem activation of the cortex. Thus it is perhaps the only known mechanism of afferent influx to the reticular formation which is capable of "damping" cortical activity and producing slow waves comparable to a state of sleep, rather than exciting or activating the cortex.

These results are particularly important since the ascending reticular activating system as the sole mechanism for maintaining wakefulness and preventing sleep has sometimes seemed inadequate to explain conditions where sleep intervenes despite exteroceptive and proprioceptive activity and even "cortical" (voluntary) effort to stay awake. These findings would seem to imply that certain conditions of emotional and sympathetic tone, particularly with sudden reduction of such tone, or possibly under fatigue which differentially affects certain components of the interlocking nervous and humoral control of activation and homeostasis, will permit a "damping" or inhibition of the ascending reticular formation in such a way as to induce sleep rather than to prevent it. The carotid sinus mechanism described, though usually subject to certain checks and balances, may under prolonged sympathetic tone and fatiguing conditions fail to react to the usual homeostatic influences and instead give rise to the afferent discharges which inhibit rather than excite the reticular activating system, thus inducing, rather than preventing, sleep. The conditions of narcolepsy (sudden and unpredictable episodes of sleep) and syncope (induced by palpation of the carotid sinus) may be examples of physiopathological conditions which could be explained in terms of this mechanism. The EEG picture in narcolepsy patients is not distinguished from that of normal persons except in the speed of the transition from waking to sleep.

Gellhorn and collaborators (47, 48, 49) have emphasized the relation of the diffuse or unspecific sensory excitation system to the specific or direct relay systems by suggesting that the former provides a physiological basis for sensation and perception and, therefore, relates to the problem of consciousness. Gellhorn (47) believes that it is the interaction of impulses from the diffuse (in his terms, hypothalamic-cortical system) projection system with those of the specific projection system which makes possible the various degrees of awareness that may be distinguished by physiological or psychological criteria. Gellhorn *et al.* (49) have demonstrated that nociceptive stimuli in lightly anesthetized cats, by interaction with acoustic or optic stimuli, lead to increased reactivity as shown by evoked potentials in the respective projection areas of each modality. However, a similar effect of interaction between sense modalities has also been demonstrated at the level of the reticular activating system by Hernández-Péon & Hagbarth (39). It is probably not a question of which is responsible for the other but merely that interaction can occur at both lower brain stem level and in the cortex. In fact interaction may occur not only between specific and unspecific afferents but between two or more sets of specific afferents [Amassian (50);



Marshall *et al.* (51)] where a substantial amount of overlapping in the specific afferent pathways occurs.

That such interplay of excitation, as Gellhorn and collaborators have described, occurs in specific projection areas and association areas seems necessary according to traditional concepts of brain function and is presumably supported by a considerable amount of clinical neurological observation. As Gellhorn (47) points out, however, the work of Lashley (52) indicates that such interaction is not necessary either for the formation or retention of complex habits as shown by removal of association areas or isolation of them from adjacent primary receiving areas of the cortex. Further evidence of this kind has been brought forth by Lashley *et al.* (53) and most recently by Sperry *et al.* (54). The work of the latter seems especially devastating to concepts of direct cortico-cortical spread and interaction, except possibly by cortico-subcortico-cortical pathways such as were proposed by Dusser de Barenne & McCulloch (55).

Recently Penfield (56) has stated,

Associative neuronal intercourse from one functional area of the cortex to another is of comparatively little importance. Integration of the function of the separate areas of the cortex by a subcortical centrencephalic system is of great importance.

And further he states,

Sensation cannot be said to be located in the cortex any more than it is in the peripheral receptor. Sensory areas of the cerebral cortex are way-stations in the current of afferent neuronal impulses. These impulses originate in the peripheral sense-organs and travel inward and upward to the cortex with ganglionic interruption in subcortical nuclei. From the cortex they pass inward again to the higher brain stem where the afferent stream from one field of the body-half can join the others. The most important, and the final, reorganization of sensory material must take place in the circuits of the higher brain stem rather than in the cerebral cortex. The motor pathway, on the other hand, which subserves voluntary discriminative movement originates in a central region between the hemispheres and passes out to the motor cortex of each hemisphere. After its ganglionic interruption in the precentral gyrus it descends to the medulla and spinal cord and thence to the muscles.

Penfield (57) explains what he means by the centrencephalic system by stating that it "must be in certain portions of the diencephalon, mid-brain and pons." This view then is similar to those of Magoun and others expressed above, in which the reticular activating system is felt to play a similar role and occupies portions of the structures named by Penfield. Penfield (56) points out that the "stream of consciousness" as well as "man's experiential record" or memory involves the temporal lobe where direct electrical stimulation in conscious man evokes flash-back memories. The hippocampus or a more central portion of the centrencephalic system may be the actual storehouse, but these bear sufficiently close functional relationship to the temporal lobes that the latter constitute the effective point of activation of such memories and experiences. The phenomena of psychomotor epilepsy, or

what is known as temporal lobe and centrencephalic seizures, as revealed in a recent book by Penfield & Jasper (58), offer much support for such a view.

Penfield's (57) extremely interesting views and evidence on the mechanism of voluntary movement point up the fact that the premotor cortex, even when isolated from surrounding cortex, can be employed in skilled voluntary movements. In this respect, the evidence is similar to that for sensory projection areas which also can function in isolation from associational zones of the cortex. Penfield indicates that not only do sensory impulses arriving at the cortex descend to central integrating centers where "highest level" final integration is presumed to take place but in their final form are impressed upon the premotor cortex for outflow to effectors. But he adds that

It seems likely that there may be an alternative pathway for directional voluntary impulses. When the motor cortex is not available it would seem that the subcortical motor mechanisms and, to a limited extent, the bulbo-spinal anterior horn centres are controlled by streams of impulses originating in the centrencephalic system without making a detour to the precentral gyrus.

Penfield (57) states that

From the point of view of this present writing, the highest level of integration might be described as that area of the central nervous system in which the final integration of nerve impulses takes place and the efferent stream of voluntary motor impulses is generated.

This is in some respects similar to a most interesting point of view, and an excellent exposition of it, by Sperry (59), who states that

all brain excitation has ultimately one end, to aid in the regulation of motor coordination. Its patterning throughout is determined on this principle. It follows that efforts to discover the neural correlates of consciousness will be more successful when directed on this basis than when guided by arbitrary correlations with psychic experience, stimulus patterns, or outside reality, or by analogies with various types of thinking machines.

He emphasizes this by stating that "*the entire output of our thinking machine consists of nothing but patterns of motor coordination.*" Hence it is by attempting to understand motor integration and adjustment that he would approach the problems of perception, thinking, and even consciousness. He believes that we have been preoccupied with "sensory avenues to the study of mental processes" and these "will need to be supplemented by increased attention to the motor patterns, and especially to what can be inferred from these regarding the nature of the associative and sensory functions."

Although the full significance of the unspecific or diffuse projection system is by no means known, it may be seen from this partial sampling of relevant literature that its role is undoubtedly a broad one. Many important papers have been omitted here, and to some extent the gaps may be filled in by consulting the volume *Brain Mechanisms and Consciousness* (2). However,

even since the publication of this volume many new papers have appeared which help to clarify one facet or another of the general relations between the classical sensory relay system and the unspecific projection system. One aspect of recent neurophysiological studies which appears to be of great importance is sensory feedback control which is related to the general organization of the diffuse projection system thalamically and to the brain stem reticular formation. These centrifugal mechanisms of control will now be described.

*Centrifugal regulation of afferent influx.*—That motor impulses from the brain to effector structures may be monitored and controlled at various relays has long been known as a segmental and suprasegmental phenomenon. Sherrington and many subsequent investigators have contributed extensively to the knowledge of this type of motor control and regulation through inhibitory and facilitatory processes.

Until relatively recently, however, a comparable type of sensory control and regulation has not been demonstrated, although it was proposed by Brouwer (60) in 1933. The first area to be brought under physiological analysis from the point of view of understanding something of the nature of centrifugal control of receptor function and afferent discharge was the muscle spindle, a proprioceptor. Although its functions had been partially inferred from the reflex studies of the Sherringtonian era at Oxford, it was Matthews (61) working with Adrian at Cambridge who first differentiated, physiologically, two types of ending in the muscle spindles. More recently these have been designated nuclear bag endings, represented by larger fibers and which respond to stretch, and myotube endings, represented by smaller fibers and which respond to contraction and shortening. Leksell (62) identified small, slow, gamma-efferent fibers which do not cause general contraction of muscle but which he concluded activate the intrafusal fibers of the muscle spindle. Kuffler *et al.* (63) confirmed this, and Hunt (64) demonstrated that the myotube endings of the muscle spindle have an autogenetic inhibitory effect upon the extensor muscle in which these endings are activated by the gamma-efferents but an excitatory effect upon the opposed flexors. Thus at the level of the spinal reflex there is a local loop control mechanism. The supraspinal control of gamma-efferents was demonstrated by Granit & Kaada (65) and Eldred *et al.* (66), who thus showed that central centrifugal control is possible through stimulation of the descending portions of the unspecific system in the brain stem. Cerebellar and cortical influence upon this system has been demonstrated by Hagbarth & Kerr (67), who have shown that stimulation of bulbar and midbrain reticular formation is capable, through descending pathways, of acting upon and depressing the activity recorded in dorsal and ventral columns, midbrain, cerebellum, and sensory cortex. This sensory-regulating mechanism is capable of acting in a tonic manner. Thus we see that in addition to local, spinal, loop control there is also supraspinal control from all essential higher levels which can operate as a centrifugal feedback controlling mechanism governing sensory input.

The role of the brain stem reticular formation in this control is very significant, for it permits not only feedback regulation of afferent impulses entering into postural adjustment, but at the same time it controls the classical relay paths to the cortex.

Similar influences have now been demonstrated for the vestibular system by Gernandt & Thulin (68), for the olfactory system by Kerr & Hagbarth (69), and for the retina by Granit (70). Thus it appears that all sense modalities have some means of centrifugal control either at the level of the receptor itself, through reflex loops, at the first or second synapse, or more centrally located stations along the afferent pathways. The importance of this cannot be overemphasized in stimulus-response integrations of continued or sequential nature. Thus a new principle of behavioral control is added to those already known.

*Unit analysis in C.N.S. by microelectrode methods.*—In the analysis of sensory receptor mechanisms microelectrodes have been used successfully for some time in the fields of vision and audition [for references to this work see Granit (4, 6); Galambos (71)]. Our concern here is with the unit analysis of electrical response in central integrating structures such as the single brain cell in various areas of the cortex, in the brain stem reticular formation, in the cerebellum, and in various nuclei of the diencephalon.

Since spontaneous rhythms (alpha, beta, and others) and evoked potentials have played such a significant role in the formation of new concepts of C.N.S. function, it is particularly significant that some understanding of the unitary composition of such electrical changes be learned. There has never been a completely satisfactory explanation as to the nature and specific origin of the spontaneous activity of the cortex and of other cellular aggregates where such rhythms are found. Similarly, although discrete mapping of evoked potentials has been possible with relatively macroelectrodes (compared to microelectrodes capable of penetrating a single brain cell), the summed effect of potentials from many cellular processes in a stratified cortex with an overlying "feltwork" and much intermixture of processes between layers has left much to be desired in the way of analysis and understanding of the various positive and negative components of the surface-recorded response. Bishop & Clare (72, 73) and others using small electrodes of 30 to 100 micra to penetrate the cortex to different depths have been able to clarify the picture considerably so far as dynamic and functional aggregates of cells are concerned. And there is some indication that this, in the end, will perhaps be the most meaningful level of electrophysiologic analysis, since the smallest functional unity so far as perception, memory, learning, and the like are concerned will never be single units but always aggregates of many units. Nevertheless, just as individual motor unit analysis in muscles by Adrian & Bronk (74) clarified the manner of functioning at that level, there is reason to believe that a knowledge obtained by sampling the activity of individual units in large assemblies of cortical and other brain cells will provide a foundation for the interpretation of activity in much larger aggregates of cells.

Renshaw *et al.* (75) were the first to record successfully the unit activity of isocortex and hippocampus in 1940, but little more was accomplished in the brain cortex until quite recently. This has been the result of many technical difficulties not the least of which has been the construction of adequate microelectrodes of a few micra in diameter in the form of micropipettes filled with an electrolyte or similar gauged metallic electrodes. The elimination of artifacts attributable to minute movement caused by tissue pulsation has been another problem. Relatively large pyramidal cells of 10 to 20 micra in diameter require extremely small microelectrodes of 1 to 5 micra for penetration of the cell body, and as a consequence the D.C. resistance of the electrodes is apt to be 30 to 50,000 ohms or higher and requires a cathode follower input circuit. Electrode manipulation requires care to avoid breakage.

Perhaps the most significant of the cortical microelectrode studies to date have been by Li & Jasper (76) and Li *et al.* (77) in the sensori-motor cortex of the cat; Baumgarten & Jung (78), Jung *et al.* (79) and Baumgarten & Baumgartner (80) in the visual cortex of the cat; and Li *et al.* (81) in human patients with various neurological and EEG abnormalities.

One of the first questions to ask of such studies concerns the nature of the alpha activity of the EEG which has played such a prominent role in evaluating the effect of psychological processes in normal subjects and in forming a criterion against which to judge abnormality in pathological cases. Also the alpha activity and other synchronized activity of a spontaneous sort has formed the background against which to judge activation or arousal via the ascending reticular activating system (brain stem reticular formation). Are these waves recorded from the surface of the scalp or from the surface of the cortex at time of operation merely envelopes of summation of spike discharges in many individual units, or is there a basic 10 per second slow rhythm detectable in the individual unit which through synchronous summation gives rise to potentials that can be recorded at a distance? Li & Jasper (76) and Li *et al.* (77) seem to confirm the latter view for they found both individual spike discharges and slow waves of a duration comparable to alpha waves. Baumgarten & Jung (78) and Jung *et al.* (79) also found slow rhythms of 10 to 50 per second, corresponding in frequency to alpha and beta waves but relatively independent of what they call macro-rhythms as in alpha activity recorded simultaneously; also periodic unit or spike discharges activated mainly on electronegative swings of associated alpha rhythms and inhibited during electropositive swings; and finally 200 to 500 per second rapid discharges in short bursts occurring normally after sensory stimulation or abnormally in association with convulsive activity and after injury. They report four types of responses of single neurones in the visual area to light stimulation: (a) no response of spontaneously active neurones to light, (b) activation of discharge after light—on-effect, (c) short inhibition after flashes of light, and (d) activation after cessation of light—off-effect of minimal potential. The latency for the on-effect is of the order of 18 to 22

msec., the off-effect perhaps 16 msec., though this response is difficult to record. Other details of the response-characteristics resemble in some respects the discharges described by Granit for single units in the retina of cats.

A Symposium on "Unit Analysis of the Electrical Activity of the Cortex" sponsored by the American EEG Society at its Chicago meeting in June, 1955 has been reported in considerable detail (82). Presentations were made by some of the country's experts in this type of recording, including, Li, Thomas, Amassian, Burns, and Bishop. The picture is a complex one, though some semblance of order is beginning to emerge. There is much hope that this type of analysis will contribute greatly to a better understanding of the electrical signals which have so far provided so much to our present knowledge of C.N.S. activity and organization.

Moruzzi (83) has brought together much of the information concerning microelectrode studies of the brain stem reticular formation, but two recent studies by Scheibel *et al.* (30) and Hernández-Péon & Hagbarth (39) deal with differential response of reticular units to stimulation of different sense modalities, and to interaction between afferent and cortically induced reticular responses, respectively. The most recent studies involving analysis of unit responses in the pyramidal system are those by Whitlock *et al.* (84) and by Calma & Arduini (85), the latter studying spontaneous and induced activity, the former observing the transition from sleep to waking. Cerebellar unit activity has been under recent study by Bremer & Gernandt (86); Tasaki *et al.* (87) have studied unit activity in the cat lateral geniculate and striate cortex; Green & Machne (88) have produced a most interesting study of unit activity in the hippocampus, which will be described in the next section.

One point about the latter study, which relates to the others involving the relationship between spike discharges of units and the over-all slow or synchronized spontaneous activity of this area: there is a tendency for groups of spikes to occur in relation to a specific phase of slow wave activity, but there are a good many exceptions to this rule. This type and degree of correlation between unit spike discharges and the slow component recordable from the cell or its environs, seem to persist in all published and reported studies the reviewer has had opportunity to see or hear. Both spontaneous and activated discharges of unit spikes occur sufficiently often at random to make the investigators feel there is no set relationship between the two; but where accelerated or grouped discharges occur there is a distinct tendency for them to fall in a given phase of the slow wave component. This observation is in line with an hypothesis originated by Bishop and Bartley in 1933, namely, that the spontaneous or alpha rhythm is accompanied by an excitability cycle which waxes and wanes with the alpha cycle and which conditions the utilization of the cortical cells involved.

Lindsley (33) has further emphasized this hypothesis and pointed to supporting data from both psychological and neurophysiological areas. A study



by Lansing (89) of reaction time in relation to the phase of occipital alpha in which the stimulus fell, and the phase of the motor alpha in which the response fell, after correction for transmission latencies, showed that for the briefest reaction times both stimulus and response fell in the same phase of the occipital and motor alpha cycles, respectively. This was taken as indirect support for the hypothesis, and it is therefore of considerable interest to note the tendency for unit discharges to fall into a particular relation with the slow (or synchronized) waves of alpha duration in the immediate environs of the discharging unit. If one assumes that the slow potential waves recorded with microelectrodes are strictly from the same unit as the spike discharges, then exceptions to the firing cycle of units are devastating to the hypothesis; however, there is some reason to believe that the slow waves are a product of the medium of a group of cortical cells, under which assumption spike discharges of a given local unit might or might not be synchronized with the other elements of the group. This problem, like many others, may well find eventual resolution in better defined knowledge of the unit activity and characteristics revealed by microelectrode studies.

*The limbic system.*—In recent years attention has been directed progressively less to the cortex as the ultimate goal of understanding, and more and more to subcortical structures. There may be many reasons for this, but one of the principal ones was undoubtedly related to the ease of access and manipulation of the grey cortical mantle relative to the difficulty of dealing with regions in depth. The development of electrical stimulating and recording systems, coupled with the use of the Horsley-Clarke stereotaxic instrument for locating quite precisely a point in space in terms of its known coordinates, has greatly facilitated exploration in the depths of the brain.

Still another reason is that as more knowledge has accumulated about the cortex from experimental and clinical studies, the concept of the cortex as the highest level of integration and control for influx and outflow of messages has been found wanting in some respects and is gradually coming to be questioned more and more. This has led to a search for hypothesized centers of control in the diencephalon and other subcortical regions. For example, Penfield (90, 91) introduced the concept of a centrencephalic system, which Penfield & Jasper (58) define as "a co-ordinating system responsible for the functional integration of the two hemispheres . . . (which) should occupy a central position between the two hemispheres . . ." The circuits of this system are located in the higher brain stem and include the thalamus with the diencephalon and the mesencephalon and rhombencephalon. From time to time Penfield has referred to the functions of this system as representing the "highest level" of integration. From his extensive work with the cortex at time of operation under local anesthesia and from his neurosurgical explorations in connection with many diverse symptoms of epilepsy such a view has gradually imposed itself upon him.

As was observed in the first section, the discovery that the brain stem reticular formation has widespread influences upon the cortex was another



spur to investigation of subcortical regions. These influences arise through the medium of any sense modality which pours sensory impulses into the reticular system via collaterals. This system plays a prominent part in the wakefulness-sleep process, in anesthesia, attention, and arousal. All of these things, and perhaps others yet unknown, help to concentrate interest in this newly discovered diffuse, unspecific projection system which monitors and modulates cortical activity and states of consciousness. In turn this brain stem system is influenced by action of the cortex and no doubt other centers which play back upon it.

Ablation studies by Bard, and others still earlier [these have been summarized by Bard (92)], tended to indicate that the diencephalon, and in particular the posterior hypothalamus, was the center of control for emotional behavior. Subsequently Bard & Mountcastle (93), in further extensions of the Cannon-Bard experiments, concluded that it was not the hypothalamus so much as the amygdala of the hippocampal region and the cingulate or transitional cortex which produced striking differences in the emotional responses of their animals. Animals (cats) could be "tamed" by one lesion and infuriated or brought to a rage state by another. It was concluded that the amygdala was a kind of funnel through which a variety of messages passed and where stimulation or a well placed lesion could have remarkable effects upon the emotional behavior of the animal.

There must be reference to the work of Klüver & Bucy (94) who demonstrated that removal of the temporal lobes in monkeys, including the amygdaloid and Ammon's formation, led to taming of a wild animal, examination of all articles within reach by mouthing them, bizarre sex behavior, failure to recognize and react to dangers and noxious and fearful stimuli, and changes in dietary habits.

In what follows it will be seen that a variety of techniques such as the anatomico-histological, electrical stimulation, electrical recording, behavioral, and others have been used to approach subcortical areas generally, and diencephalic, or perhaps better the limbic system, specifically. Space limitations will permit mention of only the most recent studies in each of these areas, but perhaps this will suffice to indicate the breadth of approach to an understanding of the limbic system, which at present seems to hold great promise for psychological concepts of emotion, motivation, drive, and possibly memory. The limbic system and the reticular activating system of the lower brain stem have some properties in common and may operate together in the maintenance of wakefulness, states of attention, and consciousness.

*Anatomico-histological considerations.*—Papez (95) in 1937 was certainly partially correct in some of his speculations, on the basis of his histological studies, about the mechanism of emotion and the structures which might be involved in it. Papez's circuit, so-called, included the hippocampus, fornix, mammillary body, anterior thalamic nucleus, cingulate cortex, and return to hippocampus. MacLean (96, 97) has reviewed the anatomical and physio-

logical literature relative to the limbic system, which he inclines to call the "visceral brain." He has brought into clear descriptive focus many of the behavioral features which clinical psychiatric patients and experimental animals with lesions or stimulation in this system seem to have in common.

Pribram & Kruger (98) have presented an excellent review and summary of the functions of what they call the "olfactory brain." This, as they point out, is a misnomer since much of the rhinencephalon and associated structures has little to do with olfaction; only certain limited parts of the system are directly involved. They classify rhinencephalic structures on the basis of ontogenetic histology, axonographic anatomy, experimental histology, and electrographic anatomy, and in the course of doing so present an excellent over-all picture. From this review they conclude that allo- and juxtallo-cortical formations may be grouped into three systems, the first of which is primarily an olfactory system with direct connections with the olfactory bulb. It includes olfactory tubercle, diagonal band, prepyriform cortex, and cortico-medial nuclei of the amygdala. The second system is not directly connected with the olfactory bulb and consists of basolateral nuclei of amygdala, the septal nuclei, frontotemporal juxtallocortex, and probably basal parts of the striatum. The third system is only remotely related to olfaction and has widespread connections with other areas both caudal and rostral. It includes Ammon's formation, cingulate cortex, and entorhinal cortex. Pribram & Kruger have reviewed the results of relevant experiments from the point of view of experimental physiology and psychology, so these will not be repeated here.

It is primarily the second and third systems as described by Pribram & Kruger that we are concerned with here; these when supplemented by the additional structures of Papez's proposed circuit and with additions to include the septal regions comprise what MacLean (97, 99) has called the limbic system.

*Recent electrophysiologic studies.*—Gloor (43) has presented very recent evidence of detailed nature on the neuronal organization and electrophysiological properties of the amygdaloid nucleus in the cat. From studies such as this it is becoming evident that rhinencephalic structures have connections with a far-flung network of other structures. Understanding of the nature of some of these circuits is just beginning to emerge and should have beneficial results upon observation and interpretation of behavioral changes induced by lesion or stimulation within selected parts of the limbic system.

An extensive study by Green & Arduini (100) of hippocampal electrical activity in arousal not only presents their specific experimental findings but constitutes a scholarly review of the anatomy and previous physiological studies of the hippocampus. They find that the hippocampus responds well to afferent stimuli even in the absence of the neocortex. However, they found an inverse relationship in the pattern of activity existing in the neocortex and hippocampus at any given time. For example, when the neocortex is desynchronized or "activated" by any variety of afferent stimulation, the

hippocampus tends to produce a 3 to 6 per second synchronized pattern; when the neocortex in sleep shows synchronized activity in the form of recurrent spindle bursts or volleys, these are accompanied in the hippocampus by desynchronization and synchronization between volleys. It should be emphasized that there are times when the same condition of synchrony or desynchrony may exist in both neocortex and hippocampus, but a reciprocal relationship tends to be the rule.

Afferent stimulation of almost any kind will serve to arouse the 3 to 6 per second waves in the hippocampus. Olfactory and tactile stimuli are especially potent in this respect for the rabbit, and auditory stimuli for the cat. In the rabbit with chronically implanted electrodes visual stimuli and movement are especially productive of arousal responses. There is no localization of these effects on the hippocampus, apparently; adaptation to a repeated stimulus is characteristic, but the response revives quickly by changes in the movement pattern of a visual stimulus or the quality of an auditory stimulus. The synchronized responses to afferent stimuli depend upon the state of alertness, for when excited after handling, there is generalized desynchronization and little response to stimulation of any kind, whereas with relaxation and quiescence, a condition requisite to synchronized or alpha activity in the neocortex, there is a strong response of synchronized rhythmic nature in the hippocampus but with subsidence of synchrony in the neocortex.

From ablation and stimulation studies, these authors conclude that there is

reason to believe that the hippocampus receives afferents by way of septo-hippocampal connections, elaborates the impulses, and discharges into the fornix proper and possibly other efferent pathways. Presumably afferent connections to the hippocampus include pathways from the reticular activating system, hypothalamus, pre-optic region and septum.

Intralaminar thalamic nuclei (part of the diffuse projection system to cortex) may also be in connection with rhinencephalic structures.

Green & Arduini point out that the inverse relationship between hippocampus and neocortex may imply that the hippocampus facilitates or induces changes in the cerebral cortex, or it may exert an inhibitory influence, or it may serve an entirely different function related to other levels of activity. A significant thing is that some reflection of any type of stimulation is registered in the hippocampus very much as it is in the brain stem reticular formation, and in both regions without very specific localization. On the other hand, the cortex receives its sensory projections in quite widely separated regions and acts differentially with respect to them. But its ability to react to the arrival of sensory impulses, signalled by evoked potentials, is dependent upon the integrity of the brain stem activating system. In other words, wakefulness, attention, discrimination, and other complex elaborations of sensory information are dependent upon the diffuse desynchronization or "activation" produced in the cortex by the unspecific sensory system

of the lower brain stem. Just what the role of the hippocampus and associated structures may be cannot at this point be said with certainty. It is interesting to note, however, that MacLean (99), on the basis of a survey of many experiments emphasizing the descriptive aspects of behavior said to be "emotional," feels that the limbic system "allows a confluence of the bodily senses and imparts to them the quality of feeling." Green & Machne (101) have recently reported on the unit activity of the rabbit hippocampus and conclude that the pyramidal cell layers contain units which are differentially responsive to different sense modalities but are intermingled rather than organized in areas. Deeper in the hippocampus individual units are found which respond to a variety of sensory stimuli.

Green & Arduini (100) have called attention to the similarity of the arousal response in the hippocampus and the 4 to 7 per second theta rhythm described by Walter (102) in the EEG. Such waves have been observed in children with behavior disorders and in psychopathic personalities. Walter emphasizes that the alpha rhythm scans for meaning, whereas the theta scans for pleasure. This view, that theta activity is associated with unpleasant situations or withdrawal of pleasant ones, might well have a bearing on the mechanism related to motivation. Unfortunately, the stimulus for the theta rhythm, under these circumstances, would not seem to correspond to the stimulus situation which elicits waves of a similar frequency in the hippocampus of the rabbit. For example, cabbage or carrot odor provokes a synchronized response in the hippocampus of the rabbit, but so also do various stimuli, some of which are noxious and undoubtedly unpleasant. There may be some connection here between hippocampal responses and cortical EEG responses known as theta waves, but the reviewer is a little skeptical of this possibility and suggests awaiting more definitive evidence linking the two.

For the present we can note that theta activity in the EEG has been associated with behavior disorders where emotional factors are prominent in aggressive, destructive, and hostile attitudes; and many other types of behavior said to be emotionally colored are evident. Also there is reason to believe that psychomotor epilepsy which involves strong affective components together with amnesia and other disturbances has a locus in or near the temporal lobe and especially in the tip and ventromedial surface, and that there is a strong possibility that the hippocampus and amygdala may be involved [Penfield & Jasper (58)].

*Behavioral studies.*—Further evidence of the importance of the limbic system for motivation and learning and for emotional behavior is highlighted in recent animal studies. Eliminating the background studies leading up to some of the following approaches because of lack of space, only the most recent studies will be mentioned in what follows.

From the Army Medical Service Graduate School in Washington has come a series of recent studies emphasizing the behavioral picture. Schreiner & Kling (103) demonstrated striking behavioral changes in the form of

hypersexuality and placidity from lesions of the amygdala. This is in agreement with the earlier studies of Klüver & Bucy (94) on temporal lobe ablation but where the lesions were found by Bucy & Klüver (104) to involve also the hippocampus and fornix. Similarly the experiments of MacLean & Delgado (105) are in essential agreement for they found that stimulation of the region in or near the amygdala produced angry, aggressive behavior.

Schreiner *et al.* (106) have shown that lesions in the dorsomedial nuclei of the thalamus produced irritability and rage responses, reduced motor activity, and impaired performance on discrimination and learning problems. Lesions of the anterior thalamic nuclei, a station on the Papez circuit, decreased rage responses and increased docility.

Brady & Nauta (107) found that septal lesions in the forebrain of rats, but probably related to the extent of damage to the column of the fornix, produced increased emotional reactivity and startle response. Conditioned emotional responses previously acquired were diminished, but the rate of acquisition of new habits was not interfered with. Brady *et al.* (108), utilizing a conditioned avoidance response technique, found that in 10 bilaterally amygdalotomized cats acquisition of the avoidance response was significantly slower than in normal or operated controls. Similar bilateral lesions in three cats after acquisition of the habit had no significant effect upon retention. Weiskrantz (109) also using a conditioned avoidance procedure with monkeys has found that bilateral lesions of the amygdala and other parts of the limbic system such as the cingulate gyrus do produce decrements in conditioned avoidance behavior.

Rosvold *et al.* (110) have shown that after lesions of the basolateral nuclei of the amygdala there are significant changes in the social behavior of monkeys. All eight of his operated monkeys showed increased aggressiveness in their individual cages, but two of the three highest in the hierarchy of dominance before operation fell from top to bottom in dominance. Pribram & Mishkin (111) and Mishkin & Hall (112) have shown that temporal lobe lesions cause impairment of visual discrimination. The latter study controlled for factors of "set" such as "comparison attitude" which it had been thought previously might be retarded after the operation and which might subsequently recover if training on other problems in visual discrimination were provided. This did not prove to be the case, for visual loss rather than "set" or "attitude" seemed responsible. Chow (113), on the other hand, presents evidence that temporal lobe lesions do produce postoperative decrements in several kinds of learning sets formed preoperatively.

A promising new line of investigation has been pioneered by Olds & Milner (114) in the rat, namely, brain self-stimulation. They have shown that with implanted electrodes in the septal region and in other areas which involve the limbic system [see also Olds (115)] an animal's performance in pressing a bar in a Skinner-type box is markedly enhanced, as if the shock it received constituted a reward. This self-stimulation procedure, when the electrode is in a positive or "rewarding" zone of the diencephalon, flows along

smoothly with the animal learning to respond and developing a typical learning curve function. When the "reinforcement" or "reward" is removed by turning off the current, extinction of the lever-pressing response occurs quickly, except for random presses. If the current is turned on again, as soon as the rat makes a few spontaneous presses and is "rewarded," he continues to build up a typical responding rate. Not all areas explored are rewarding; some are areas resulting in avoidance or inhibition. Olds (115) feels that even some rewarding areas may have both facilitatory and inhibitory effects depending upon the nature of the rewarding circumstance. The fact that positive areas (high rates of responding) have tended to be associated with some part of the second limbic system described by Pribram & Kruger seems significant at this point in these investigations. No doubt revisions of concepts will follow when a more systematic exploration of spatial variables has been accomplished and when temporal and other characteristics of the stimulating current have been investigated thoroughly. It appears now as a very promising means of investigating motivation and perhaps learning something of the basic structure and mechanism underlying it.

*Concluding statement.*—In looking back over the impressive developments in neurophysiology, especially during the past 10 years, it becomes obvious a new orientation is being gained about the nervous system and that this orientation includes more than ever before a direct relation to behavioral phenomena. Phenomena such as sleep, wakefulness, attention, emotional arousal, and even perceptual discrimination, learning, motivation, and drive are beginning to be anchored to some system in the general organization of the brain. An understanding of how these conditions or processes arise, the most effective ways to facilitate or inhibit them, and other general and specific characteristics which influence them are being uncovered. The time seems ripe for psychology to participate in this movement so as not to be left behind with out-moded and out-dated concepts. Many of our concepts have never had a very sound basis of understanding for we have worked with them at a rather superficial level. To understand something of the mechanism and the requirements of the nervous system's role in behavior will provide anchoring points from which behavioral and psychophysical studies may proceed with greater assurance and with greater benefits to psychology and neurophysiology alike.

#### LITERATURE CITED

1. Lindsley, D. B., *Ann. Rev. Physiol.*, **17**, 311-38 (1955)
- 1a. Lindsley, D. B., *Crossroads of Psychology and Neurophysiology* [Address delivered to Section I (Psychology), American Association for the Advancement of Science, Berkeley, Calif., December, 1954]
2. Adrian, E. D., Bremer, F., and Jasper, H. H., Consulting Eds. *Brain Mechanisms and Consciousness* (Blackwell Scientific Publications, Oxford, England, 556 pp., 1954)
3. Brazier, M. A. B., *EEG Clin. Neurophysiol.*, **6**, 355-59 (1954)



4. Granit, R., *Receptors and Sensory Perception* (Yale University Press, New Haven, Conn., 369 pp., 1955)
5. Chang, H.-T., *J. Neurophysiol.*, **18**, 425 (1955)
6. Granit, R., *Sensory Mechanisms of the Retina* (Oxford University Press, London, England, 412 pp., 1947)
7. Alvarez-Buylla, R., and Ramirez de Arellano, J., *Am. J. Physiol.*, **172**, 237-44 (1953)
8. Gray, J. A. B., and Sato, M., *J. Physiol. (London)*, **122**, 610-36 (1953)
9. Davis, H., Tasaki, I., and Goldstein, R., *Cold Spring Harbor Symposia Quant. Biol.*, **17**, 143-57 (1952)
10. Tasaki, I., and Fernández, G., *J. Neurophysiol.*, **15**, 497-512 (1952)
11. Békésy, G. von, *J. Acoust. Soc. Amer.*, **24**, 399-409 (1952)
12. Katz, B., *J. Physiol. (London)*, **111**, 261-82 (1950)
13. Hunt, C. C., and Kuffler, S. W., *J. Physiol. (London)*, **113**, 298-315 (1951)
14. Hartline, H. K., Wagner, H. G., and MacNichol, E. F., *Cold Spring Harbor Symposia Quant. Biol.*, **17**, 125-41 (1952)
15. Kuffler, S. W., *J. Neurophysiol.*, **16**, 37-68 (1953)
16. Enroth, C., *Acta Physiol. Scand.*, **27**, Suppl. 100, 52 pp. (1952)
17. Dodt, E., and Enroth, C., *Acta Physiol. Scand.*, **30**, 375-90 (1953)
18. Donner, K. O., *Acta Physiol. Scand.*, **21**, Suppl. 72, 59 pp. (1950)
19. Riggs, L. A., Ratliff, F., Cornsweet, J. C., and Cornsweet, T. N., *J. Opt. Soc. Amer.*, **43**, 495-501 (1953)
20. Riggs, L. A., Armington, J. C., and Ratcliff, F., *J. Opt. Soc. Amer.*, **44**, 315-21 (1954)
21. Moruzzi, G., and Magoun, H. W., *EEG Clin. Neurophysiol.*, **1**, 455-73 (1949)
22. Lindsley, D. B., Bowden, J., and Magoun, H. W., *EEG Clin. Neurophysiol.*, **1**, 475-86 (1949)
23. Lindsley, D. B., Schreiner, L. H., Knowles, W., and Magoun, H. W., *EEG Clin. Neurophysiol.*, **2**, 483-98 (1950)
24. French, J. D., and Magoun, H. W., *Arch. Neurol. Psychiat.*, **68**, 591-604 (1952)
25. French, J. D., von Amerongen, F. K., and Magoun, H. W., *Arch. Neurol. Psychiat.*, **68**, 577-90 (1952)
26. Magoun, H. W., *Physiol. Revs.*, **30**, 459-74 (1950)
27. Magoun, H. W., *Research Publs. Assoc. Nervous Mental Disease*, **30**, 480-92 (1952)
28. Magoun, H. W., *EEG Clin. Neurophysiol.*, Suppl. 4, 163-67 (1953)
29. Jasper, H., Naquet, R., and King, E. E., *EEG Clin. Neurophysiol.*, **7**, 99-114 (1955)
30. Scheibel, M., Scheibel, A., Mollica, A., and Moruzzi, G., *J. Neurophysiol.*, **18**, 309-31 (1955)
31. French, J. D., Verzeano, M., and Magoun, H. W., *Arch. Neurol. Psychiat.*, **69**, 505-18 (1953)
32. French, J. D., Verzeano, M., and Magoun, H. W., *Arch. Neurol. Psychiat.*, **69**, 519-29 (1953)
33. Lindsley, D. B., *EEG Clin. Neurophysiol.*, **4**, 443-56 (1952)
34. Lindsley, D. B., in *Handbook of Experimental Psychology*, 473-516 (Stevens, S. S., Ed., John Wiley & Sons, Inc., New York, N. Y., 1436 pp., 1951)
35. Hebb, D. O., *Psychol. Rev.*, **62**, 243-54 (1955)



36. Jasper, H., Ajmone-Marsan, C., and Stoll, J., *Arch. Neurol. Psychiat.*, **67**, 155-66 (1952)
37. Bremer, F., and Terzuolo, C., *Arch. intern. physiol.*, **61**, 86-90 (1953)
38. French, J. D., Hernández-Péon, R., and Livingston, R. B., *J. Neurophysiol.*, **18**, 74-95 (1955)
39. Hernández-Péon, R., and Hagbarth, K.-E., *J. Neurophysiol.*, **18**, 44-55 (1955)
40. Cohn, R., *J. Nervous Mental Disease*, **104**, 351-57 (1946)
41. Lindsley, D. B., in *The Second Int'l Symposium on Feelings and Emotions*, 238-46 (Reymert, M. L., Ed., McGraw-Hill Book Co., Inc., New York, N. Y., 1950)
42. Mollica, A., Moruzzi, G., and Naquet, R., *EEG Clin. Neurophysiol.*, **5**, 571-84 (1953)
43. Gloor, P., *EEG Clin. Neurophysiol.*, **7**, 223-42, 243-64 (1955)
44. Bonvallet, M., Dell, P., and Hiebel, G., *EEG Clin. Neurophysiol.*, **6**, 119-44 (1954)
45. Darrow, C. W., Kronenberg, G., and Pathman, J., *J. Exptl., Psychol.*, **36**, 355-65 (1946)
46. Darrow, C. W., and Graf, C. G., *J. Neurophysiol.*, **8**, 449-62 (1945)
47. Gellhorn, E., *Pflügers Arch. ges Physiol.*, **255**, 75-92 (1952)
48. Bernhaut, M., Gellhorn, E., and Rasmussen, A. T., *J. Neurophysiol.*, **16**, 21-35 (1953)
49. Gellhorn, E., Koella, W. P., and Ballin, H. M., *J. Neurophysiol.*, **17**, 14-21 (1954)
50. Amassian, V. E., *Research Pubs. Assoc. Nervous Mental Disease*, **30**, 371-402 (1952)
51. Marshall, W. H., Woolsey, C. N., and Bard, P., *J. Neurophysiol.*, **4**, 1-24 (1941)
52. Lashley, K. S., *Symposia Soc. Exptl. Biol.*, **4**, 454-82 (1950)
53. Lashley, K. S., Chow, K. L., and Semmes, J., *Psychol. Rev.*, **58**, 123-36 (1951)
54. Sperry, R. W., Miner, N., and Meyers, R. E., *J. Comp. Physiol. Psychol.*, **48**, 50-58 (1955)
55. Dusser de Barenne, J. G., and McCulloch, W. S., *J. Neurophysiol.*, **1**, 364-77 (1938)
56. Penfield, W., in *Proc. 14th Intern. Congr. Psychol.*, 47-69 (North-Holland Publishing Co., Amsterdam, Holland, 256 pp., 1955)
57. Penfield, W., *Brain*, **77**, 1-17 (1954)
58. Penfield, W., and Jasper, H., *Epilepsy and the Functional Anatomy of the Human Brain*, 438-516 (Little, Brown & Co., Boston, Mass., 896 pp., 1954)
59. Sperry, R. W., *Am. Scientist*, **40**, 291-312 (1952)
60. Brouwer, B., *J. Nervous Mental Disease*, **77**, 621-27 (1933)
61. Matthews, B. H. C., *J. Physiol. (London)*, **78**, 1-33 (1933)
62. Leksell, L., *Acta Physiol. Scand.*, **10**, Suppl. 31, 84 pp. (1945)
63. Kuffler, S. W., Hunt, C. C., and Quilliam, J. P., *J. Neurophysiol.*, **14**, 29-54 (1951)
64. Hunt, C. C., *Proc. 19th Intern. Physiol. Congr.*, 485-86 (Montreal, Canada, 1953)
65. Granit, R., and Kaada, B. R., *Acta Physiol. Scand.*, **27**, 130-60 (1952)
66. Eldred, E., Granit, R., and Merton, P. A., *J. Physiol. (London)*, **122**, 498-523 (1953)
67. Hagbarth, K.-E., and Kerr, D. I. B., *J. Neurophysiol.*, **17**, 295-307 (1954)

68. Gernandt, B. E., and Thulin, C.-A., *J. Neurophysiol.*, **18**, 113-29 (1955)
69. Kerr, D. I. B., and Hagbarth, K.-E., *J. Neurophysiol.*, **18**, 362-74 (1955)
70. Granit, R., *J. Neurophysiol.*, **18**, 388-411 (1955)
71. Galambos, R., *Physiol. Revs.*, **34**, 497-528 (1954)
72. Bishop, G. H., and Clare, M. H., *J. Neurophysiol.*, **15**, 201-20 (1952)
73. Bishop, G. H., and Clare, M., *J. Neurophysiol.*, **16**, 490-98 (1953)
74. Adrian, E. D., and Bronk, D. W., *J. Physiol. (London)*, **67**, 119-51 (1929)
75. Renshaw, B., Forbes, A., and Morison, B. R., *J. Neurophysiol.*, **3**, 74-105 (1940)
76. Li, C.-L., and Jasper, H., *J. Physiol. (London)*, **121**, 117-40 (1953)
77. Li, C.-L., McLennan, H., and Jasper, H., *Science*, **115**, 656-57 (1952)
78. Baumgarten, R. von, and Jung, R., *Rev. neurol.*, **87**, 151-55 (1952)
79. Jung, R., Baumgarten, R. von, and Baumgartner, G., *Arch. Psychiat. Nervenkrankh.*, **189**, 521-39 (1952)
80. Baumgarten, R. von, and Baumgartner, G., *Nervenarzt*, **24** (11), 475 (1953)
81. Li, C.-L., Jasper, H., and Henderson, L., Jr., *EEG Clin. Neurophysiol.*, **4**, 513-26 (1952)
82. American EEG Society—Symposium: Unit Analysis of the Electrical Activity of the Cortex, *EEG Clin. Neurophysiol.*, **7**, 475-94 (1955)
83. Moruzzi, G., in *Brain Mechanisms and Consciousness*, 21-53 (Blackwell Scientific Publications, Oxford, England, 556 pp., 1954)
84. Whitlock, D. G., Arduini, A., and Moruzzi, G., *J. Neurophysiol.*, **16**, 414-29 (1953)
85. Calma, I., and Arduini, A., *J. Neurophysiol.*, **17**, 321-35 (1954)
86. Bremer, F., and Gernandt, B. E., *Acta Physiol. Scand.*, **30**, 120-36 (1954)
87. Tasaki, I., Polley, E. H., and Orrego, F., *J. Neurophysiol.*, **17**, 454-74 (1954)
88. Green, J. D., and Machne, X., *Am. J. Physiol.*, **181**, 219-24 (1955)
89. Lansing, R. W., *The Relationship of Brain and Tremor Rhythms to Visual Reaction Time* (Doctoral thesis, Univ. of California at Los Angeles, Los Angeles, Calif., 1954)
90. Penfield, W., *Arch. Neurol. Psychiat.*, **40**, 417-42 (1938)
91. Penfield, W., *Research Publ. Assoc. Nervous Mental Disease*, **30**, 513-28 (1952)
92. Bard, P., *Research Publ. Assoc. Nervous Mental Disease*, **19**, 190-218 (1939)
93. Bard, P., and Mountcastle, V. B., *Research Publ. Assoc. Nervous Mental Disease*, **27**, 362-404 (1948)
94. Klüver, H., and Bucy, P. C., *Arch. Neurol. Psychiat.*, **42**, 979-1000 (1940)
95. Papez, J. W., *Arch. Neurol. Psychiat.*, **38**, 725-43 (1937)
96. MacLean, P. D., *Psychosomat. Med.*, **11**, 338-53 (1949)
97. MacLean, P. D., *J. Neurosurg.*, **11**, 29-44 (1954)
98. Pribram, K. H., and Kruger, L., *Ann. N. Y. Acad. Sci.*, **58**, 109-38 (1954)
99. MacLean, P. D., *Arch. Neurol. Psychiat.*, **73**, 130-34 (1955)
100. Green, J. D., and Arduini, A. A., *J. Neurophysiol.*, **17**, 533-57 (1954)
101. Green, J. D., and Machne, X., *Am. J. Physiol.*, **181**, 219-24 (1955)
102. Walter, W. G., *The Living Brain* (W. W. Norton & Co., New York, N. Y., 311 pp., 1953)
103. Schreiner, L., and Kling, A., *J. Neurophysiol.*, **16**, 643-59 (1953)
104. Bucy, P. C., and Klüver, H., *Arch. Neurol. Psychiat.*, **44**, 1142-46 (1940)
105. MacLean, P. D., and Delgado, J. M. R., *EEG Clin. Neurophysiol.*, **5**, 91-100 (1953)
106. Schreiner, L., Rioch, D. McK., Pechtel, C., and Masserman, J. H., *J. Neurophysiol.*, **16**, 234-46 (1953)

107. Brady, J. V., and Nauta, W. J. H., *J. Comp. Physiol. Psychol.*, **46**, 339-46 (1953)
108. Brady, J. V., Schreiner, L., Geller, I., and Kling, A., *J. Comp. Physiol. Psychol.*, **47**, 179-86 (1954)
109. Weiskrantz, L., *Am. Psychologist*, **8**, 452 (1953)
110. Rosvold, H. E., Mirsky, A. F., and Pribram, K. H., *J. Comp. Physiol. Psychol.*, **47**, 173-78 (1954)
111. Pribram, K. H., and Mishkin, M., *J. Comp. Physiol. Psychol.*, **48**, 198-202 (1955)
112. Mishkin, M., and Hall, M., *J. Comp. Physiol. Psychol.*, **48**, 97-101 (1955)
113. Chow, K. L., *J. Comp. Physiol. Psychol.*, **47**, 194-98 (1954)
114. Olds, J., and Milner, P., *J. Comp. Physiol. Psychol.*, **47**, 419-27 (1954)
115. Olds, J., in *Nebraska Symposium on Motivation*, 73-139 (Jones, M. R., Ed., Univ. of Nebraska Press, Lincoln, Nebr., 274 pp., 1955)

## GERONTOLOGY (LATER MATURITY)<sup>1</sup>

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Since Shock's review on gerontology (later maturity) in 1951 (93), there has been a steady increase in the literature about the aging process. Specialized reviews have been made relating the findings to education for later maturity (99), emphasizing psychological adjustment in aging (92), and relating aging to job fitness (35). Dennis (35), moreover, has focussed attention on research needs and the limitations of some research methods.

In the last few years many of the publications have emphasized the social and individual welfare consequents of aging. This concern is reflected in the nonexperimental reports about rehabilitation, therapy, and psychotherapy in the later years. The field has seen an increase in studies on employability and retirement and family relations of older persons. The literature generally has been oriented around the challenge of caring for the old who cannot adequately care for themselves. The research studies, for the most part, have been based on empirical age differences in cross-sectional samples at different chronological ages. Only a few report data on age-changes based on longitudinal evaluation of the same individuals at successive points in their lives, and these few deal primarily with the maintenance of intellectual abilities in the elite.

The general accent of the literature has been on facts and the implication of these facts for the care of the old. There has not been any genuine interest in theory. Some articles hint at aspects of theory but none has done more than suggest a classification of the available facts. Riesman (88), for instance, has attempted to bring his cultural concepts to bear on a typology of adjustment to the aging process. He describes but does not explain three kinds of old persons: the "autonomous" who are independent of culture because for them aging brings increments in wisdom without loss of spontaneity, the "adjusted" who seem to maintain themselves only as long as the cultural situation is favorable, and the "anomic" who decay as soon as physiological vitality is lost because the culture no longer supports them. Riesman's typology not only oversimplifies adjustment in the aging process but overstates the negative aspects of the changes that age brings.

A much more positive classification is suggested in Linden & Courtney's (65) hypothesis that in middle life there is psychophysical interruption at or near involution which ends in a period they name evocescence. This period is followed by senescence, "rich both in actuality and potential." They suggest the need to make a developmental scale for the way an individual handles senescence in terms of social growth and social behavior. They suggest that adjustment depends upon the way an individual conceptualizes chrono-

<sup>1</sup> The survey of the literature pertaining to this review was completed in April, 1955.

logical age, the kinds of expectations he has set for himself, and the way others regard him in his age and sex roles. In their paper Linden & Courtney compare the stages of maturation as suggested by Shakespeare, by Erikson, and by their more positively oriented scheme. Slotkin (96), too, compares stages in the life process to suggest that of Buehler's five stages; the two requiring more research are the "testing" and "indulgence" periods of middle life. He implies that individual conflict results from those who feel that their goals have been achieved without satisfying basic needs and desires.

#### PERSONALITY

In a review of personality of the aged, Watson (102) suggests that research now is in a naturalistic and exploratory stage which usually precedes theoretically and experimentally based study. He suggests that recent evidence is based on the notion "a person is as old as his self concept." Caldwell (29) has summarized the results of recent studies involving the Rorschach in the aging process. Apparently, the researcher finds what he seeks. The most carefully planned investigation of Rorschach responses in old age (7) attempted to determine if differentiation in responses could be made among individuals in the seventies, eighties, and nineties. For most Rorschach scoring categories, no age differences were found, nor did the records of the institutionalized differ from those of "normal" adults. Since no differences were found, the protocols were classified into normal and senile; two lists of Rorschach signs were proposed which formed the basis of the classification. Unfortunately, the schema was not validated upon an alien group of protocols.

Brozek (23) made an item analysis of the Minnesota Multiphasic Personality Inventory differentiations between college students and comparable business and professional men in the age range from 45 to 55 years. The older group seem somewhat more introverted than the college students although both are more extroverted than the normal population. On more than 140 items significant age differences were found between the two groups. For the older group, the direction of the differences suggests diminished physical fitness, diminished interest in strenuous and adventurous activities, greater tension about work and emotional adjustments, but better social adjustment to relatives and family. The age differences are in general accord with what other questionnaire studies have found.

Lorge *et al.* (67) compared the drawings of the self by graduate students and by institutionalized old. In contrast to the human figure drawings by graduate students, the drawings of older people were characterized by incompleteness, lack of integration, flatness, lack of proportion, bizarreness, and evidence of inadequate motor coordination. It must be recognized that their sample of the old is a biased sample of individuals in the later years

#### ATTITUDES

In primitive societies there is no uniformity in the attitude toward, and

treatment of, the aged. Lips (66) emphasizes the need to go beyond the cultural stereotype in estimating societies' reactions to the old. Barron (10) suggests that the aged have taken on the characteristics and behavior of a minority group. The general resentment by older workers about the discrimination against them may be considered analogous to minority group responses.

In order to get facts for a sound welfare program for the aged in society, several studies have been completed. The information, based usually on interviews, adds to the available facts about age differences. In Connecticut the second study on old age and retirement (74) reported the prospects for economic security and the retirement plans of farm operators and laborers as well as their attitude toward old age and survivors' insurance. The findings indicate the impact of a changed agriculture on the rural tradition of filial responsibility for care of the old with its consequent demand for a new kind of security. Only about half of the farmers, regardless of age, believe that agriculture provides security for the later years. They feel that federal or state insurance plans must make economic security possible. In a survey for the Connecticut Commission on the Potentials of Aging (75) an intensive study was made of men and employed women aged 55 to 64 years and men and women aged 65 to 74 who had been employed. The percentage of employables "without restriction" in the earlier decade was 71 and in the second decade was 44; for women the percentages were 84 and 54. The reasons given for continuing to work after age 65 were: "needed money," 45 per cent; "enjoyed work," 10 per cent; and "to keep occupied," 31 per cent. In a corresponding California survey (17) of a sample of persons at least 65 years old, the attitudes of the old with reference to family organization and functioning were found to depend upon three factors: the current trend toward earlier marriage, the decreasing size of families, and increasing life span. Children of older adults report themselves to be unwilling to let their parents get old age assistance from the state or nation, although this reluctance is much less for the children with less schooling. The survey is rich in data about interests, attitudes, and activities of older adults.

Smith (97) surveyed two Pennsylvania communities with respect to plans for retirement and old age. Most of the persons looked to government rather than individual resources in planning for later maturity. Planning for old age was positively correlated with income, occupational level, and age.

Tuckman & Lorge (101) continued studies of subjective appraisal of periods of the life span. Any age period beyond the twenties was considered less favorable than childhood, adolescence, or early maturity by graduate students and by institutionalized old. Feifel (39) found similar results for psychiatric patients. Lebo (61) found that happiness in old age was dependent upon health and minimal financial support. Happy old people were more alert and flexible than the unhappy old. Lehman (62, 63) continued the appraisal of the best years of life. His *Age and Achievement* is a compendium of information about the productivity of the publicized elite. In a study of

the professional reading and productivity of psychologists, Dennis & Girden (34) found professional reading greater in the twenties and thirties and professional publication greater in the thirties and forties than in the later years.

Using a specially developed attitude scale toward employment of older employees, Kirschner & Dunnette (58) found that the respondent's age was a major determinant of his attitude but that relative age within his work group also affects his responses. Pressey & Jones (87), in the fourth 10-year survey since 1923 of time and age changes on The X-O Form with college undergraduates and adults 20 to 70 years, found that the decrease in the number of borderline activities (like smoking) considered wrong has continued its steady decrement from 1923 to 1943 to 1953. Although older adults marked more items as wrong than did the younger group, they marked just as many as young people did in the decades when these adults were young. Adults do not show increasing conservatism as much as retention of attitudes acquired earlier. Adult graduate students (90) showed no relation between social attitudes and intelligence.

#### FAMILY RELATIONS

Gravatt (48) reviewed the studies and theories about family relations in middle life and old age emphasizing the need for longitudinal methods. Koller (60) summarizes his three studies of three-generation households indicating that such households provide extra difficulties in interpersonal living. Anderson (8) suggests that it is the older members of the family unit who do not participate in informal social activities with other families. Albrecht (2 to 6) reports on intergeneration parent attitudes: the relation of older people with their own parents and with their children and of parental responsibilities of grandparents. The pattern suggests strong attachment of the older generations with the younger. Albrecht's work was part of a larger study (52).

#### ADJUSTMENT

In a study of the adjustment of immigrants (105) in Israel, 18 to 21 year olds adjusted best, 40 to 54 year olds worst, and older people living near their children satisfactorily. Moberg (80) reports that those old people who had formerly been leaders in the church were better adjusted than those who never had held leadership positions but (79) that there was no difference between church members and nonchurch members in old age personal adjustment. Burgess (25) in a study of residents at Moosehaven found a relation between the type of personal socializing and recreational participation. A statistical comparison of the rate of socialization resulting from a seven-month experimental activity program indicated a difference between two experimental and two "control" homes for the aged (36). Mack (68) found the chronically ill less happy than the normal old. The hopeful ill were better adjusted than the resigned ones. The ill, however, do not see themselves as different from the normal old.



## REHABILITATION AND THERAPY

In an experimental-control design with sex hormone replacement, Caldwell & Watson (30) found evidence that such therapy makes for increase in intellectual potential and flexibility as well as in motivation in old women. A survey of the occupational potentialities of the older cardiac patients (22) indicates that substantial numbers are gainfully employed without adverse effect.

In an intensive attempt to increase the employability of the difficult-to-place adult (age or physical disability), Feintuch (40) reports that experimentally treated persons demonstrated increased placement and stability in employment.

In more formal psychiatric therapy, Ross' (89) review indicates the encouraging results of psychiatric treatment in the aged. Meerloo (76) points out the values of psychoanalysis in the aged indicating the need to understand the changed attitudes of the old toward the body, sexual problems, and the environment. Wayne (103) gives the rules for a modified psychoanalytic therapy in senescence. So-called "brief" therapy (46, 47), given to the old at widely spaced sessions, leads to useful results. Linden (64) finds that group psychotherapy brings about great improvement in 45 per cent of senile women. Ginzberg (45) recommends a combination of group and individual attention in geriatric and psychiatric management.

## RETIREMENT

A major concern for gerontology is the impact of retirement: the economic aspects (26), the industrial policy (27), and the effect upon the individual (100) have been reviewed. Industrial practices (20) of progressive corporations on hiring, transmotion, and retiring indicate an increased concern for psychological adjustment to shifts in expectancies. Boyle (19) surveyed the practices of industry in giving the retired employee a sense of belonging with the company and the community. The retired constitute a new leisure class (77) with a tendency to a new social life (104) which comes as consequent of mobility (71).

The reasons for retirement at age 65 years in England (82) were chronic illness or ill-health for 51 per cent of those retiring. The primary reasons for continuing work, however, were also physical: feeling fit, prefer to work, "employer needs me." In a study of the effects of retirement (95) the evidence suggests that prolonged inactivity and the absence of marked positive interests lead to mental and physical ill-health in the aged, more among men than women. Myers (81) indicates a logical error in interpreting mortality as a sequel to retirement. He believes that voluntary retirement is associated with ill-health but that compulsory retirement at a specified age is not, with the result that there will be a differential mortality rate for the two classes. The Cleveland survey of retired men (86) casts doubt on the so-called difficulties of postretirement adjustment. The Chicago studies by Havighurst and his colleagues (42, 51, 53, 91) indicate that work and, hence, re-

tirement from it, have different meanings in the occupational ladder. For the unskilled and semiskilled they mean money income, but for the professional they mean service.

#### EMPLOYMENT AND EMPLOYABILITY

A comprehensive review of the problems in the employment of older workers (54) indicates the need to recognize the existence of discrimination against the so-called old workers, problems of adaptability and retraining as a consequent of technological change, and the obstacle of pension plans. Fleming (41) indicates that industry must capitalize on the skills of the older worker while Barkin (9) goes further to suggest the need to redesign jobs to make for maximal utilization of man-power potential. Barkin suggests that industry must change its attitude toward hiring older workers by benefiting from new methods of making transfer of earlier skills to new jobs, by reducing "time stress," and by changing the relation between machine and man. Evidence for Barkin's position is Bowers' (18) study which found that older workers though viewed as slower in learning seem to make it up in better attendance, steadiness, and dependability. Workers hired between age 45 and 60 learned and worked satisfactorily. In general, the data show negligible age differences but great variability at every age.

Belbin (12) described the difficulties that older people experienced in 32 industrial firms as reported by direct inquiry at the workshop level. In training, age difficulties were said to occur before age 40 primarily on time stress operations. Where sensori-motor skill was required, the reported difficulties began in the mid-twenties. In general, acquired skills, however, are maintained through the working life.

#### LEARNING

Very few experimental studies of learning appeared in recent years. Hanes (50) contrasted the perceptual learning of three different age groups, 20 to 34, 35 to 49, and 50 to 70 years. The results indicate no genuine differences in reorganization of previously acquired learning but a significant age decrement in learning new associations. Under the Nuffield Research Unit into Problems of Ageing, Kay (56) studied a complex type of sensori-motor utilization of information in workers in six age groupings from 15 to 72 years. On the interpretation of printed directions, there was a progressive decrement in the proportion of each age group that could carry out the directions correctly from 60 per cent for 15 to 24 years, to 20 per cent for 65 to 72 years. Errors and time increase at each successive age and with increasing difficulty of the task. The older subjects showed a tendency to repeat their erroneous performances despite the negative information about their errors.

#### INTELLIGENCE

The data for generalizations about intelligence over the life span usually were developed by cross-sectional studies and were based on mixed speed and

power tests. The results suggested decline from the early twenties throughout the rest of life. Wechsler's (106) new Adult Intelligence Scale, restandardized on a nationwide sample, gives evidence that intelligence does not decline as markedly as he had suggested 20 years ago. Indeed, Bennett (13) indicates that the restandardization sample for the new Wechsler gives a better description of the abilities of American men and women throughout the age range, particularly in the older years. The new data (106) yield highest raw scores for the verbal in the age range 25 to 34 years, with very small decrements to the middle fifties. On the performance scale, however, highest scores were achieved in the age range 20 to 24 years, with relatively small decrements to the middle forties. As usual, the performance tests are more heavily weighted for speed than are the verbal subtests, reflecting known changes in speed of performance and sensory decline. Wesman (107) discusses some problems involved in a representative sampling for the norming of an adult intelligence test. Not only does he discuss costs but, more importantly, emphasizes the difficulty in persuading the selected individuals to participate in the program. The new Wechsler used subjects in the Kansas City aging surveys. Perhaps the studies of Maleci and his co-workers (69, 70) of the Italian translation of the old Wechsler-Bellevue test show the source of the difficulties in interpreting speed and power scores. In comparing subjects in the age range 50 to 60 years with subjects aged 20 to 25 years, he finds a decrement of 7 points in the verbal scale and 11 in the performance. In the younger group, however, 72 per cent had substantial amounts of elementary schooling, whereas only 24 per cent of the older group had such education. Since education makes a difference, the test results are contaminated by the different educational attainments of the widely separated age groups. The Maleci group also report that the deterioration coefficient is zero for the young, and significant for the older group, indicating the differential between performance and verbal scores. Dörkin & Greenbloom (38) report that Copple's senescent decline quotient is a more valid indicator of senile decrement than is Wechsler's deterioration index. Using patients in a Veterans' Domiciliary, Berkowitz (14) administered the Wechsler-Bellevue test to white males beyond the age of 50. On the basis of the average scores, test performances decline more rapidly in the two decades before age 60 than in the years following. The digit symbol, the block design, and the picture arrangements decrease, however, with every successive decade, whereas the object assembly, comprehension, digit span, and similarities decreased to the sixth decade with no further decrement to the eighties. Domiciliary subjects are not typical of the population of the United States. Corsini & Fassett (33), using the Wechsler-Bellevue, tested adult prisoners. They used the 15/50 ratio suggested by Kuhlen, i.e., how well do 50-year olds perform in comparison with 15-year olds. A ratio of 1 equals parity, a ratio less than 1 inferiority, and a ratio greater than 1 superiority. For the adults over the age of 49, they report a ratio of 1.09 for verbal, .78 for performance, and .92 for the total test. Verbal aspects of intelligence do not decline from early to late ma-

turity, but performance subtests reflect visual and motor decrements. Their data anticipated the norms for the new Wechsler.

Owens (85), on the basis of a follow-up of college freshmen 30 years later, indicates that there are statistically significant increases on the Army Alpha on the subtests for practical judgment, synonym-antonym, and disarranged sentences over the 30-year period. The only subtest that shows a loss is arithmetic reasoning but the loss is not statistically significant. Owens indicates that gains from freshman to senior status may be probable with possible subsequent loss in the intervening 30 years, implying an increment to the middle twenties with a very slow decrement to the early fifties. But the later scores still tend to be superior to their freshman scores. Bayley & Oden (11) followed the gifted children in the Terman study from the average age of  $29\frac{1}{2}$  to  $41\frac{1}{2}$  years. Scores on the concept mastery test were consistently higher at the second administration. The test-retest correlation was .88 for the gifted, and for their spouses the correlation over a 12-year span was .92. Gains occur at all educational levels but were somewhat greater among those with less education.

The last two studies were based on superior members of the population. Indeed, Birren (15) in his review not only suggests that mental abilities vary in the rate of change with age, but that the upper 5 per cent consistently remain above the average. His review emphasizes that intellectual impairment attributable to brain damage is infrequent in the later years. Dörken's (37) review of psychometric difference between senile dementia and normal senescent decline demonstrates that senile dementia is not an advanced phenomenon of normal old age but that it is qualitatively and quantitatively different from normal senescent decline. Some studies suggest differences in responses to the same tests by young and old. Clay (32) tested subjects under 25 and over 55 years on a task of arranging numbers in rows and columns to form a specified marginal total on four problems of increasing complexity. The results showed that the performances of young and old were similar on the simplest problem, but as the complexity increased, older subjects not only took more time but also were less active in correcting their errors and less accurate. Bromley (21), using the Matrices test in the age range 40 to 80 years, indicates that older respondents give more personal associations, more simplified and concrete ideas, more global impressions, more pattern reversals, and more mechanical matching than do younger. He reports a consistent inability to shift or to hold two aspects of the same pattern simultaneously. Calogera (31), using Lamparter's "bunch of grapes" test on subjects over age 60, reports diminished participation and increased rigidity in test performance. A large number of the old show indifference to the test, and many more refused to do it.

Birren *et al.* (16) reported on the performances of three groups of adults in the age range from 16 to 90 years. The task was single column addition of different lengths under time limits. The adults sampled constituted different populations, i.e., the younger were in public schools, the middle ages were

selected from adult education classes, and the older ages either came from a general hospital or were selected patients in homes for the aged. Their data indicate decreased accuracy and increased time in successive age groups. They suggest that increasing age requires greater amounts of time in perception of digits, in the actual addition, and in the writing down of the response as well as loss in accuracy as evidenced in errors of perception, in addition, in carrying partial sums, and in writing the answer. They propose a model to account for the age differences in performances of different task lengths in terms of information theory. It is suggested that loss in speed in the old is functionally related to mental performance.

#### PHYSICAL CHANGES AND PHYSICAL HEALTH

In general, the recent empirical evidence about physical decline confirms the established facts as reviewed by Kleemeier (59). McFarland *et al.* (72) review the relation between age and employment and accidents in truck drivers. Although most truck drivers are under 40 years of age, accident proneness does not increase in the later ages primarily because of the greater experience of the older drivers. For the "younger" occupation of aircrewmembers, Miles & Shriver (78) collected critical incidents of effective and ineffective performances related to chronological age. About three-fifths of the incidents were about ineffective behaviors, and of these more than 40 per cent were related to physical disabilities, especially proneness to fatigue. In addition, many incidents were related to decreased motivation for flying with increments in age. McFarland (73) reviews the literature relating to aging of air transport pilots. He suggests that although pilots over 50 years will show expected losses in homeostasis, hearing, and vision, the declines are rarely of importance in actual operation. The older pilot has problems in critical judgment in complex situations in short spans of time. Aging and accident rate may be related to experience as well as motivation and physical declines. King & Speakman (57), in discussing the relation between age and industrial accidents, suggest that the reported high accident rate in those under 30 years may be attributable to inexperience, and the low accident rate in the later years may be a function of experience, selective elimination or both.

Obrist (83) reports simple auditory reaction time in the age range 18 to 39, 65 to 75, and 76 to 86 not only in averages but also for within-person variability. For the 18 to 39 year-olds, the average in milliseconds was 122; for the 65 to 75 year-olds, 131; and for the 76 to 86 year-olds, 145. The within-person variability increases from 9.3 to 11.0 to 14.0, which indicates not only loss in speed but increase in variability. Gaskell & Zinina (43) suggest that the cortical activity in old age reflects a weakening in inhibitory processes, initially evident in speech functions, resulting in lengthened latent times with consequent difficulty in forming conditional reflexes. Green & Bender (49), using simultaneous cutaneous perception of double tactile stimulation to the face and hand on the same side and on a different side, for those aged 40 to 64, 65 to 74, 75 to 84, and 85 to 96 years, found that the

elderly made as large a proportion of errors as children under six years. After 10 trials of double stimulation, the percentage of error was 8, 42, 54, and 75 in the four successive age groups.

Age changes in metabolism and respiratory functions were measured by Shock & Yienst (94) for subjects aged 40 to 90 years. They found differences among the age groups in expiration of oxygen and carbon dioxide, as well as in heat production. While these measures are intercorrelated, the data indicate that with increasing age there is a significant loss in basal heat production and in carbon-dioxide elimination. No significant age trend was found in respiratory rate, total ventilation volume, or tidal volume. As suggested by Obrist (83), individual differences are significant in the appraisal of physical attributes. Shock & Yienst, too, show significant variability not only among individuals but from day to day.

Obrist (84) found in the electroencephalograms of 150 normal males 65 to 96 years old a higher incidence of slightly "slow EEG's as compared with young, and middle-aged, adults." These electroencephalograms of old people generally are of lower voltage and greater irregularity with disorganized rhythm. Busse *et al.* (28) studied EEG in individuals in three community groups and one hospitalized group over 60 years. A larger percentage show focal dysrhythmia, primarily in the left temporal areas. Dysrhythmia alone, however, is unrelated to psychological functions, e.g., Rorschach, Weigl Color Form Sorting, Successive Eights, or the Wechsler. They do report, however, that diffuse slowing in the EEG is accompanied by intellectual deterioration.

Brozek (24) reviews the relation between physical activity and body composition. He reports primarily his own study on body composition in two groups of middle-aged men differing in the amounts of habitual physical exercise. Active men, although heavier than the inactive, had less adipose tissue, i.e., fatness is associated with the lack of physical exercise. Jokl (55) studied Deutscher-Turner Bund members to determine whether regular bodily exercise delayed the aging process. He reported the motor abilities of older athletes not only were better than those of persons of corresponding age without such practice but also better than those of postadolescents. He suggests an inhibition of negative aspects of aging as a function of continuous physical activity.

Sorsby (98) continued his study on the causes of blindness. He reports a steady increase in the proportion of the aged in the blind population. Since 1923, the percentage of individuals over 70 years in the blind population increased progressively from 22.4 to 47.4 in 1951. This increase in proportion has been higher for women than for men. Except for some mitigation by exercise and activity, sensory and physical declines continue to be the general finding in recent research.

Albrecht (1) collected information about the personal health of a hundred subjects over 65. The main complaints were about losses in vision and hearing and about hip and leg difficulty that interfered with walking, but 21



per cent reported no uncorrected physical problem. The most comprehensive survey on the physical and mental problems was made by senior medical students on a representative sampling of the over 65 group in Groningen, Netherlands (108). The survey covered sociological, physical, and psychological aspects. Memory and attitudes are analyzed by age, indicating significant memory losses in successive age groups, especially in lower socioeconomic groups, and that attitudes in the less well educated reflect ignorance and misinformation. Ginzberg (44) indicated that county homes are viewed as "end of the road" institutions even though more than a third of the residents are psychiatrically normal.

#### DISCUSSION

In the last few years, the major emphasis of the gerontological literature has been oriented around the emerging problems involved in caring for "Our Needy Aged." The needy old are those individuals at or beyond some arbitrary age who seem to require economic assistance, medical aid, or psychological help. Society is well advised to give help to the needy.

Psychologists, however, must recognize that not all the old are needy. A major difficulty, at least in psychological research, is in obtaining a truly representative sample of all older persons which will include the correct proportion of the needy, of those who can care for themselves, and of those able to care for themselves and others. The great danger is that the description of the old may be based on those available in institutions or in hospitals. More attention must be given to reducing the possibility of bias in the samples tested or appraised. The bias, moreover, is not always negative. Indeed, many generalizations in gerontology are based on observations of, or records about, the intellectual or social or occupational elite among the old.

Gerontology, as a discipline, is not only concerned about understanding the old as they are but also in comprehending their current behavior in terms of their past adjustments and achievements as individuals. Age differences may provide hypotheses, but only data about changes in the same persons over the life span can supply the evidence for demonstrating their truth. Longitudinal studies, despite their many pitfalls, are needed on a representative sample of persons throughout their lives to provide the data needed to verify whether age differences are identical with age changes.

In addition to the need for better samples and for longitudinal studies, there is a need for a theoretical formulation of the problem of aging. Description, of course, must precede theory. It cannot remain, however, a substitute for it.

Gerontology cannot subsist on clichés or stereotypes whether they be about intellectual decline, or about attitudinal conservatism, or about physiological irreversibility. The clichés pose areas for investigation, and the results shown lead to sounder theoretical formulations for getting knowledge of the processes that are called aging.



## LITERATURE CITED

1. Albrecht, R., "Social Factors in the Health of Older People," *Geriatrics*, **8**, 106-10 (1953)
2. Albrecht, R., "Relationship of Older People with Their Own Parents," *Marriage and Family Living*, **15**, 296-98 (1953)
3. Albrecht, R., "Intergeneration Parent Patterns," *J. Home Econ.*, **46**, 29-32 (1954)
4. Albrecht, R., "The Parental Responsibilities of Grandparents," *Marriage and Family Living*, **16**, 201-4 (1954)
5. Albrecht, R., "Relationship of Older Parents with Their Children," *Marriage and Family Living*, **16**, 32-35 (1954)
6. Albrecht, R., "Relationship of Older People with Their Own Parents," *Marriage and Family Living*, **15**, 296-98 (1953)
7. Ames, L. B., Learned, J., Metraux, R. W., and Walker, R. N., *Rorschach Responses in Old Age* (Harper & Brothers, New York, N. Y., 229 pp., 1954)
8. Anderson, W. A., "Some Factors Associated with Family Informal Participation," *Dept. Rural Sociol., Cornell Univ., Mimeographed Bull. No. 36* (1953)
9. Barkin S., "Job Redesign: Technique for an Era of Full Employment," in Haber, W. et al., *Manpower in the United States: Problem and Policies*, 39-50 (Harper & Brothers, New York, N. Y., 1954)
10. Barron, M. L., "Minority Group Characteristics of the Aged in American Society," *J. Gerontol.*, **8**, 477-82 (1953)
11. Bayley, N., and Oden, M. H., "The Maintenance of Intellectual Ability in Gifted Adults," *J. Gerontol.*, **10**, 91-107 (1955)
12. Belbin, R. M., "Difficulties of Older People in Industry," *Occupational Psychol. (London)*, **27**, 177-90 (1953)
13. Bennett, G. K., "Flexible Retirement Plans and Mental Efficiency," *Trans. N. Y. Acad. Sci.*, **17**, 33-36 (1954)
14. Berkowitz, B., "The Wechsler-Bellevue Performance of White Males Past Age 50," *J. Gerontol.*, **8**, 76-80 (1953)
15. Birren, J. E., "Age Changes in Mental Abilities," *J. Business*, **27**, 156-63 (1954)
16. Birren, J. E., Allen, W. R., and Landau, H. G., "The Relation of Problem Length in Simple Addition to Time Required, Probability of Success, and Age," *J. Gerontol.*, **9**, 150-61 (1954)
17. Bond, F. A., Baber, R. E., Veig, J. A., Perry, L. B., Scaff, A. H., and Lee, L. J., Jr., *Our Needy Aged: A California Study of a National Problem* (Henry Holt & Company, Inc., New York, N. Y., 401 pp., 1954)
18. Bowers, W. H., "An Appraisal of Worker Characteristics as Related to Age," *J. Appl. Psychol.*, **36**, 296-300 (1952)
19. Boyle, C. P., "Helping Employees Adjust to Retirement. II: A Survey of Post-Retirement Practices in Industry," *Personnel*, **29**, 441-52 (1953)
20. Breckinridge, E. L., *Effective Use of Older Workers* (Wilcox & Follett Co., Chicago, Ill., 244 pp., 1953)
21. Bromley, D. B., "Primitive Forms of Response to the Matrices Test," *J. Mental Sci.*, **99**, 374-93 (1953)
22. Bronstein, L. H., Goldwater, L. J., and Kresky, B., "Occupational Potentialities of the Older Cardiac Patient," *Geriatrics*, **8**, 252-58 (1953)
23. Brozek, J., "Personality Changes with Age: An Item Analysis of the Minnesota Multiphasic Personality Inventory," *J. Gerontol.*, **10**, 194-206 (1955)

24. Brozek, J., "Physical Activity and Body Composition," *Archiv. Hig. Rada*, **5**, 193-212 (1954)
25. Burgess, E. W., "Social Relations, Activities, and Personal Adjustment," *Am. J. Sociol.*, **59**, 352-60 (1954)
26. Burns, R. K., "Economic Aspects of Aging and Retirement," *Am. J. Sociol.*, **59**, 384-90 (1954)
27. Burns, R. K., "Some Unsettled Issues of Retirement Policy," *J. Business*, **27**, 137-45 (1954)
28. Busse, E. W., Barnes, R. H., Silverman, A. J., Shy, G. M., Thaler, M., and Frost, L. L., "Studies of the Process of Aging: Factors that Influence the Psyche of Elderly Persons," *Am. J. Psychiat.*, **110**, 897-903 (1954)
29. Caldwell, B. McD., "The Use of the Rorschach in Personality Research with the Aged," *J. Gerontol.*, **9**, 316-23 (1954)
30. Caldwell, B. McD., and Watson, R. I., "An Evaluation of Sex Hormone Replacement in Aged Women," *J. Genet. Psychol.*, **85**, 181-200 (1954)
31. Calogera, E., "Ricerche Caratterologiche Sulla Personalita Senile Mediante Il Test Del 'Grappolo D'Uva,' Modificato Sanguineti-Sigurta," *Arch. psychol. neurol. psychiat.*, **14**, 184-85 (1953)
32. Clay, H. M., "Changes of Performance with Age on Similar Tasks of Varying Complexity," *Brit. J. Psychol.*, **45**, 7-13 (1954)
33. Corsini, R. J., and Fassett, K. K., "Intelligence and Aging," *J. Genet. Psychol.*, **83**, 249-64 (1953)
34. Dennis, W., and Girden, E., "Current Scientific Activities of Psychologists as a Function of Age," *J. Gerontol.*, **9**, 175-78 (1954)
35. Dennis, W., *Age and Behavior: A Survey of the Literature* (Report No. 1, Project 21-0202-0005, Air University School of Aviation Medicine, Randolph Air Force Base, Randolph Field, Texas, 146 pp., 1953)
36. Donahue, W., Hunter, W. W., and Coons, D., "A Study of the Socialization of Old People," *Geriatrics*, **8**, 656-66 (1953)
37. Dörken, H., Jr., "Psychometric Differences Between Senile Dementia and Normal Senescent Decline," *Can. J. Psychol.*, **8**, 187-93 (1954)
38. Dörken, H., Jr., and Greenbloom, G. C., "Psychological Investigation of Senile Dementia: II. The Wechsler-Bellevue Adult Intelligence Scale," *Geriatrics*, **8**, 324-33 (1953)
39. Feifel, H., "Psychiatric Patients Look at Old Age: Level of Adjustment and Attitudes toward Aging," *Am. J. Psychiat.*, **111**, 459-65 (1954)
40. Feintuch, A., "Improving the Employability and Attitudes of the 'Difficult-to-Place' Persons," *Psychol. Monographs*, **69**, No. 392 (1955)
41. Fleming, C., "The Employment of the Elderly in Industry," *Brit. J. Phys. Med.*, **16**, 75-78 (1953)
42. Friedmann, E. A., Havighurst, R. J. et al., *The Meaning of Work and Retirement* (University of Chicago Press, Chicago, Illinois, 197 pp., 1954)
43. Gakkel', L. B., and Zinina, N. V., "Izmeneniia vys shel nervnoi deiatel' nosti u liudei v vozraste svyshe 60 let," *Fiziol. Zhur. S.S.S.R.*, **39**, 533-39 (1953)
44. Ginzberg, R., and Brinegar, W. C., "Psychiatric Problems in Elderly Residents of County Homes: Report and Evaluation of a Survey Conducted in County Homes in Iowa," *Am. J. Psychiat.*, **110**, 454-59 (1953)
45. Ginzberg, R., "Geriatric Ward Psychiatry: Techniques in the Psychological Management of Elderly Psychotics," *Am. J. Psychiat.*, **110**, 296-300 (1953)

46. Goldfarb, A. I., and Sheps, J., "Psychotherapy of the Aged. III: Brief Therapy of Interrelated Psychological and Somatic Disorders," *Psychosomat. Med.*, **16**, 209-19 (1954)
47. Goldfarb, A. I., and Turner, H., "Psychotherapy of Aged Person., II: Utilization and Effectiveness of 'Brief' Therapy," *Am. J. Psychiat.*, **109**, 916-21 (1953)
48. Gravatt, A. E., "Family Relations in Middle and Old Age," *J. Gerontol.*, **8**, 197-201 (1953)
49. Green, M. A., and Bender, M., "Cutaneous Perception in the Aged," *Arch. Neurol. Psychiat.*, **69**, 577-81 (1953)
50. Hanes, B., "Perceptual Learning and Age," *J. Consulting Psychol.*, **17**, 222-24 (1953)
51. Havighurst, R. J., "Flexibility and the Social Roles of the Retired," *Am. J. Sociol.*, **59**, 309-11 (1954)
52. Havighurst, R. J., and Albrecht, R., *Older People* (Longmans, Green & Co., New York, N. Y., 415 pp., 1953)
53. Havighurst, R. J., and Shanas, E., "Retirement and the Professional Worker," *J. Gerontol.*, **8**, 81-85 (1953)
54. Anonymous, "The Problem of the Employment of Older Workers," *Intern. Labour Rev.*, **66**, 594-618 (1954)
55. Jökl, E., *Alter und Leistung* (Springer Verlag, Berlin, Germany, 75 pp., 1954)
56. Kay, H., "The Effect of Position in a Display upon Problem Solving," *Quart. J. Exptl. Psychol.*, **6**, 155-69 (1954)
57. King, H. F., and Speakman, D., "Age and Industrial Accident Rates," *Brit. J. Ind. Med.*, **10**, 51-58 (1954)
58. Kirchner, W. K., and Dunnette, M. D., "Attitudes toward Older Workers," *Personnel Psychol.*, **7**, 257-65 (1954)
59. Kleemeier, R. W., "Age Changes in Psychomotor Capacity and Productivity," *J. Business*, **27**, 146-55 (1954)
60. Koller, M., "Studies of Three-Generation Households," *Marriage and Family Living*, **16**, 205-6 (1954)
61. Lebo, D., "Some Factors Said to Make for Happiness in Old Age," *J. Clin. Psychol.*, **9**, 385-87 (1953)
62. Lehman, H. C., "Men's Creative Production Rate at Different Ages and in Different Countries," *Sci. Monthly*, **78**, 321-26 (1954)
63. Lehman, H. C., *Age and Achievement* (Princeton University Press, Princeton, N. J., 359 pp., 1953)
64. Linden, M. E., "Group Psychotherapy with Institutionalized Senile Women: Study in Gerontologic Human Relations," *Intern. J. Group Psychother.*, **3**, 150-70 (1953)
65. Linden, M. E., and Courtney, D., "The Human Life Cycle and its Interruptions: A Psychologic Hypothesis. Studies in Gerontologic Human Relations, I," *Am. J. Psychiat.*, **109**, 906-15 (1953)
66. Lips, E., "Alter und Behandlung der Alten bei Naturvölkern," *Z. Altersforschung*, **7**, 1-18 (1953)
67. Lorge, I., Tuckman, J., and Dunn, M. B., "Human Figure Drawing by Younger and Older Adults," *Am. Psychologist*, **9**, 420-21 (1954)
68. Mack, M. J., "Personal Adjustment of Chronically Ill Old People under Home Care," *Geriatrics*, **8**, 407-16 (1953)

69. Maleci, O., and Montanari, M., "Il Test Wechsler-Bellevue in Soggetti Anziani Normali," *Arch. psicol. neurol. psichiat.*, **14**, 591-602 (1953)
70. Maleci, O. and Pessina, G., "Su Alcune Elaborazioni del Punteggio Wechsler-Bellevue in Soggetti Normali della Provincia di Padova," *Riv. patol. nervosa e mentale*, **75**, 1-23 (1954)
71. Manley, C. R., Jr., "The Migration of Older People," *Am. J. Sociol.*, **59**, 324-31 (1954)
72. McFarland, R. A., Moseley, A. L., and Fisher, M. B., "Age and the Problems of Professional Truck Drivers in Highway Transportation," *J. Gerontol.*, **9**, 338-48 (1954)
73. McFarland, R. A., "Psycho-physiological Problems of Aging in Air Transport Pilots," *J. Aviation Med.*, **25**, 210-20 (1954)
74. McKain, W. C. Jr., Baldwin, E. D., and Ducoff, L. J., "Old Age and Retirement in Rural Connecticut, 2: Economic Security of Farm Operators and Farm Laborers," *Storrs Agr. Expt. Sta., Bull. No. 299*, 51 pp. (1953)
75. McKain, W. C., Jr., *Report of the Connecticut Commission on the Potentials of the Aging*, 125 pp. (1954)
76. Meerloo, J. A. M., "Contributions of Psychoanalysis to Problems of the Aged," in Heiman, M., *Psychoanalysis and Social Work* (International Universities Press, New York, N. Y., 346 pp., 1953)
77. Michelson, L. C., "The New Leisure Class," *Am. J. Sociol.*, **59**, 371-78 (1954)
78. Miles, W. R., and Shriver, B. M., "Aging in Air Force Pilots," *J. Gerontol.*, **8**, 185-90 (1953)
79. Moberg, D. O., "Church Membership and Personal Adjustment in Old Age," *J. Gerontol.*, **8**, 207-11 (1953)
80. Moberg, D. O., "Leadership in the Church and Personal Adjustment in Old Age," *Sociol. Social Research*, **37**, 312-16 (1953)
81. Myers, R. J., "Factors in Interpreting Mortality after Retirement," *J. Am. Stat. Assoc.*, **49**, 267, 499-509 (1954)
82. National Insurance Retirement Pensions, *Reasons for Retiring or Continuing Work*, (Her Majesty's Stationery Office, London, England, 136 pp., 1954)
83. Obrist, W. D., "Simple Auditory Reaction Time in Aged Adults," *J. Psychol.*, **35**, 259-66 (1953)
84. Obrist, W. D., "The Electroencephalogram of Normal Aged Subjects," *EEG Clin. Neurophysiol.*, **6**, 235-44 (1954)
85. Owens, W. A., Jr., "Age and Mental Abilities: A Longitudinal Study," *Genet. Psychol. Monographs*, **48**, 3-54 (1953)
86. Payne, S. L., "The Cleveland Survey of Retired Men," *Personnel Psychol.*, **6**, 81-110 (1953)
87. Pressey, S. L., and Jones, A. W., "Age Changes in Moral Codes, Anxieties, and Interests, as shown by the 'X-O' Tests," *J. Psychol.*, **39**, 485-502 (1955)
88. Riesman, D., "Some Clinical and Cultural Aspects of Aging," *Am. J. Sociol.*, **59**, 359-83 (1954)
89. Ross, M., "Some Psychiatric Aspects of Senescence: A Review of the Literature," *Psychiat. Quart.*, **28**, 93-112 (1954)
90. Rubin-Rabson, G., "Intelligence and Conservative-Liberal Attitudes," *J. Psychol.*, **37**, 151-54 (1954)
91. Shanas, E., and Havighurst, R. J., "Retirement in Four Professions," *J. Gerontol.*, **8**, 212-21 (1953)

92. Shock, N. W., "Aging and Psychological Adjustment," *Rev. Educ. Research*, **22**, 439-58 (1952)
93. Shock, N. W., "Gerontology (Later Maturity)," *Ann. Rev. Psychol.*, **2**, 353-70 (1951)
94. Shock, N. W., and Yiengst, M. J., "Age Changes in Basal Respiratory Measurements and Metabolism in Males," *J. Gerontol.*, **10**, 31-40 (1955)
95. Silverman, M., "Psychological and Social Aspects of Psychiatric Disorders in the Aged," *J. Mental Sci.*, **99**, 257-64 (1953).
96. Slotkin, J. S., "Life Course in Middle Age," *Social Forces*, **33**, 171-77 (1954)
97. Smith, W. M., Jr., "Family Plans for Later Years," *Marriage and Family Living*, **16**, 36-40 (1954)
98. Sorsby, A., *The Causes of Blindness in England*, (Her Majesty's Stationery Office, London, England, 41 pp., 1953)
99. Tibbitts, C., and Donahue, W., "Developments in Education for Later Maturity," *Rev. Educ. Research*, **23**, 202-17 (1953)
100. Tibbitts, C., "Retirement Problems in American Society," *Am. J. Sociol.*, **59**, 301-8 (1954)
101. Tuckman, J., and Lorge, I., "Old People's Appraisal of Adjustment over the Life Span," *J. Personality*, **22**, 417-22 (1954)
102. Watson, R. I., "The Personality of the Aged. A Review," *J. Gerontol.*, **9**, 309-15 (1954)
103. Wayne, G. J., "Modified Psychoanalytic Therapy in Senescence," *Psychoanal. Rev.*, **40**, 99-116 (1953)
104. Webber, I. L., "The Organized Social Life of the Retired: Two Florida Communities," *Am. J. Sociol.*, **59**, 340-46 (1954)
105. Weinberg, A. A., "Problems of Adjustment of New Immigrants to Israel," *World Mental Health Bulletin of World Federation for Mental Health*, **5**, 57-63 (1953)
106. Wechsler, D., *Manual for the Wechsler Adult Intelligence Scale* (The Psychological Corporation, New York, N. Y., 110 pp., 1955)
107. Wesman, A. G., "Standardizing an Individual Intelligence Test on Adults: Some Problems," *J. Gerontol.*, **10**, 216-19 (1955)
108. van Zonneveld, R. J., *Gezondheidsproblemen bij Bejaarden* (Van Gorcum and Co., Assen, The Netherlands, 248 pp., 1954)

## VISION<sup>1,2,3</sup>

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This was the first year of publication of a new European journal, *Optica Acta*, devoted to optics and vision; the first few numbers indicate that it will be a source for many excellent experimental reports.

In April, 1953 a colloquium on optical problems of vision was held at the Institute of Optics at Madrid. Although the proceedings of the colloquium were briefly summarized in 1953 in a technical report by Graham (1) for the Office of Naval Research, the first volume (2) of the complete report of this meeting did not appear until 1955. The report contains the four invited papers delivered at the colloquium: "La Vision Binoculaire aux Faibles Excitations" by Yves Le Grand, "Further Studies of Visual Mechanisms by the Two-Colour Threshold Method" by W. S. Stiles, "Research on Chromatic Vision by Electrophysiological Means" by Ragnar Granit, and "The Chemistry of Visual Excitation" by George Wald. The papers are primarily reviews but contain some results not previously published.

Granit's Silliman Memorial Lectures at Yale have been published (3) and provide an excellent survey of some of the properties of sensory systems. Books by Allport (4) and Ittelson & Cantril (5) summarize some of the problems and data of perception.<sup>4</sup>

### PHYSIOLOGICAL MECHANISMS

#### SOME OPTICAL AND MECHANICAL CHARACTERISTICS OF PERIPHERAL SYSTEMS

The concept of stray light as a theoretical tool for explaining the effects of "glare" sources, of cross-regional adaptation effects, etc., is a familiar one in the visual literature. Several experiments during the past year report direct and quantitative measurements on this problem.

Boynton, Enoch & Bush (7) describe results obtained from cat and steer eyes and one human eye. Their method involves mounting the eye in a holder, cutting a 2 mm. aperture through the sclera, choroid, and retina, and placing a phototube at this aperture. With this recording system, they presented stimuli of varying area and field position. Transmission to the re-

<sup>1</sup> The survey of the literature pertaining to this review was completed in April, 1955.

<sup>2</sup> The following abbreviations are used in this chapter: cff (critical flicker frequency); C. I. E. (Commission Internationale d'Eclairage); ERG (electroretinogram).

<sup>3</sup> The preparation of this manuscript was supported by a contract between the Office of Naval Research and Columbia University. Reproduction in whole or in part is permitted for any purpose of the United States Government.

<sup>4</sup> A monograph by Clausen (6), published in Copenhagen, which summarizes work on visual phosphenes was received too late to be included in this review.

ording point was a function of the angle of the "glare" source, being high at angles near zero (measuring point near theoretical image of source), and decreasing in an S-shaped fashion with increasing "glare" angle. Stray light had decreased by a factor of 1000 when the glare angle was  $24^\circ$ . The light entering the recorder aperture was directly proportional to the total flux incident on the eye. A comparison of these direct measurements with estimates of glare made on the basis of psychophysical measurements shows that the psychophysical estimates are realistic in terms of order of magnitude. Ranke (8), using a similar method with the ox eye, obtained results of the same order of magnitude (0.1 per cent for a glare angle of  $20^\circ$ ). He measured the transmission out to an angle of  $70^\circ$ , by which point it is approximately constant at about  $10^{-4}$  its maximum value.<sup>5</sup>

A point emphasized by the Boynton, Enoch & Bush experiment is that scattering is not restricted to the presence of light outside the geometrical image; the increase in light in the region of the center of the image is also an important consideration. They found an increment of 14 per cent at the center of the image as the area was increased from  $4.76^\circ$  to  $20.76^\circ$ . This magnitude of change is comparable to the changes in threshold reported by Steinhard (10) in his study of  $\Delta I$  as a function of area, and by Graham, Brown & Mote (11) in their study of absolute threshold as a function of area.

The time course of contraction and dilation of the pupil has been plotted by Young & Biersdorf (12) with the use of a high speed camera and an infra-red light source. Contraction latency is longer if the pupil is dilating than it is if the pupil diameter is stable; similarly, dilation latency is longer when the pupil is contracting, rather than stable. Their data suggest that for optimal test conditions, dilation and contraction latencies are equal. In a more extended study of pupil action, Cüppers (13) measured the magnitude and time course of both the direct and consensual pupil response as a function of the intensity, the exposure time, and size of the stimulus.

Several investigations have concerned themselves with the quantification of eye movements. Five techniques that have been used to measure eye movements are reviewed by Riggs, Armington & Ratliff (14). They discuss some of the technical details and problems of each method and present experimental data obtained by one method that involves the attachment of a small mirror to a contact lens. The magnitude and frequency of eye tremors obtained with this method, when compared with measurements using a corneal reflection technique, indicate that the contact lens follows the small oscillatory movements of the eye. The authors present probability distributions of the magnitude of these oscillatory movements and find that

<sup>5</sup> There are indications from a report by Stegemann (9) that the photographing *in situ* of the spread of illumination around the retinal image in humans may provide additional information on this scattering problem.



the median amplitude of excursion is a linearly increasing function of exposure time in the range from 0.01 to 1.0 sec. Measurements of eye movements by recording electrical potentials developed in the region of the eye ball have been reported by Ten Doesschate & Lansberg (15), Mackensen & Harder (16), and Hodgson & Lord (17). For rotations of the eye up to  $30^\circ$ , there is an approximately linear relation between potential amplitude and angle of rotation, and some of the individual differences in amplitude obtained are apparently attributable to the location of the eye ball within the orbital cavity.

The importance of eye movements for visual discrimination was demonstrated in a novel way in 1952 by Riggs & Ratliff (18), who placed a contact lens in the optical path of the stimulus object. Ditchburn (19) has used a similar technique of stabilizing the retinal image and has shown that contrast sensitivity and visual acuity are reduced in the absence of the very rapid oscillations of the retinal image.

#### PHOTOCHEMICAL AND CHEMICAL PROPERTIES OF THE VISUAL SYSTEM

The last decade has provided us with an ever increasing rate of acquisition of specific details that are necessary for understanding the biochemistry of the visual system and conceptualizing the role this chemical system plays in determining the characteristics of the response to radiant energy.

Crescitelli & Dartnall (20) report on a visual pigment from the dark adapted eye of the carp that has a maximum absorption at  $523 \text{ m}\mu$ ; they feel that this substance is different from the typical pigment found in fresh water fish. Dartnall (21) arrives at a similar conclusion for a pigment from the eye of the clawed toad which has a corrected absorption maximum at  $519 \text{ m}\mu$ . However, on the basis of measurements of Vitamin  $A_1$  and  $A_2$  content in the bleached retinae of this animal, Wald (22) feels that the significance of Dartnall's observation lies, not in the suggestion of a new visual pigment, but in the demonstration that this adult anurid possesses some fraction of porphyropsin.

Also in the toad, Dartnall, using a "difference spectrum" technique,<sup>6</sup> regards the variations in the spectral curves, obtained with several bleaching procedures, as evidence for the existence of an auxiliary photosubstance with a peak absorption around  $570 \text{ m}\mu$ , in addition to the primary pigment with a maximum at  $519 \text{ m}\mu$ . If such a substance is demonstrated, it would be consistent with measurements by Denton & Pirenne (24) on the spectral sensitivity of this animal. With narrow band filters, Denton & Pirenne measured the amount of light required to elicit an "escape" response. The sensitivity curve showed a marked peak at approximately  $560 \text{ m}\mu$ .

<sup>6</sup> Some of the difficulties in interpreting "difference spectra" [see, e.g., Collins (23)] should be considered if we are interested in distinguishing an active "visual pigment" from, for example, the absorption curves for some photoproduct.

Hagins (25) has found that the photosensitivity of rhodopsin, i.e., the product of quantum efficiency and molar extinction coefficient, is greater for mammalian rhodopsin *in situ* than for rhodopsin in digitonin solutions solidified as agargels and treated in the same way as excised eyes. He suggests that the explanation for this difference may lie in the orientation of rhodopsin chromophores in the rods or the high index of refraction of the medium in which the pigment is distributed or both.

Campbell & Rushton (26) have described a method for measuring changes in rhodopsin concentration in the intact human eye. With this method, a light beam enters the eye, is reflected from the choroid, and collected and received by a photomultiplier tube. A rotating color wheel presents orange and blue-green stimuli alternately and a purple filter in the light path equalizes the phototube response for these two stimuli. Any change in rhodopsin concentration will be indicated by an inequality of the two phases of this phototube response. Rushton *et al.* (27) have used this method to study the time course of bleaching and regeneration of rhodopsin in the living eye of humans and of albino rabbits. The rates and amounts of bleaching and regeneration depend on time and the intensity of the stimulus, but the magnitudes obtained are not consistent with the threshold or sensitivity changes measured in light and dark adaptation, if the absorption coefficient is the only consideration in the latter. These results may be added to the array of data suggesting that properties other than the "quantum catching" power of an absorbing medium are required of a satisfactory theory of light and dark adaptation.

Wald (28) determined the changes in the extinction coefficient of a rhodopsin solution as a function of the time of exposure to white light. He also measured dark adaptation in the human eye following exposure to each of three luminance levels. On the basis of the psychophysical and photochemical data, he estimates that a 5 sec. exposure to a 10 m.L. stimulus only bleaches from 1200 to 1600 molecules. Wald then presents a model that attempts to meet the requirement of large changes in sensitivity with small changes in the absorbing medium. Briefly, the theory assumes that the rod cell is a compartmentalized cell, that each compartment has a number of molecules in it, that when any molecule changes it fires the compartment and the sense cell, and therefore that a single quantum can fire a single dark adapted rod. In recovery from adaptation, no compartment can function until its last rhodopsin molecule has been regenerated.

Some of the data on the chemical basis of vision are summarized by Wald (29) and by Collins (23). Wald's article is his Sigma Xi lecture and is written for a more heterogeneous reading public. Collins reviews some of the structural and chemical properties of the peripheral visual mechanism and emphasizes some of the limitations to our knowledge in this area, as well as some of the advances. The literature on the physiological chemistry of the eye for the year 1953 has been surveyed in a review by Sallmann (30). It

covers a large number of studies on each of the ocular structures and contains a section by Hubbard on the visual pigments.

#### ELECTRICAL ACTIVITY IN THE VISUAL SYSTEM

*Electroretinogram.*—Armington & Thiede (31) have continued the analysis of the human ERG. They determined the height of the *x*-wave as a function of intensity for eight stimulus areas ranging from  $1.27^\circ$  to  $30^\circ$ . It may be recalled that the *x*-wave is considered as primarily photopic, the *b*-wave primarily scotopic, although it is already clear that this dichotomy is, at best, an approximate one. An increase in either the area or the intensity of the stimulus increases the height of the *x*-wave, and the data indicate that *x*-waves are elicited with less total flux when large areas are used.

In a second paper, Armington & Thiede (32) report the effects of colored adapting stimuli on the *x*- and *b*-waves. Typically, in the dark adapted eye, the *b*-wave masks the photopic component. In the eye adapted to intermediate levels the waveform depends on the wavelength of the stimulus. For long wavelengths, two distinct components, *x*- and *b*-waves, are recordable; for short wavelengths, the latency of the *b*-wave decreases and blends with the *x*-wave. In this experiment the adapting field consisted of a white surround with a central colored adapting field  $30^\circ$  in diameter in which colored test stimuli were presented. With a white surround of 0.006 ftL, the sensitivity curve bears a rough resemblance to the scotopic visibility curve, except that it shows excessive sensitivity in the blue. When the eye is adapted to a 2 ftL, white surround, the sensitivity curve has a peak at approximately 540 m $\mu$ . If the central  $30^\circ$  field contains a red adapting stimulus, the sensitivity curve is depressed in the red end of the spectrum. For a blue central adapting field, the resulting sensitivity curve is depressed throughout, with relatively uniform sensitivity in the range from 500 to 630 m $\mu$ . If the eye is adapted to green, the sensitivity curve shows a depression at approximately 580 m $\mu$ . These results are consistent with the human psychophysical data on selective adaptation and offer another instance of the intimate quantitative linkage between physiological and behavioral data in the sensory area (see discussion of Auerbach & Wald below).

Wirth & Zetterström (33) have utilized an experimental procedure that permits them to separate the integrative action of the retina from the grosser effects attributable to scattered light. After removing the cornea and lens, cutting the iris to increase its opening, and removing part of the vitreous humor, they inserted Perspex cones of various diameters to limit stray light. Using focused spots of various sizes, they studied the retinal response as a function of intensity. For sizes smaller than 3 mm, the waveform of the response had the characteristics of a low intensity response, and it could not be changed in form by increasing the intensity.

Measurements of photopic sensitivity by means of the electroretinal response to flickering stimuli have been reported by Johnson & Cornsweet

(34). They used a 30/sec. repetition of a 10 msec. flash in the dark adapted eye. With a constant peak-to-trough magnitude as the response criterion, the sensitivity curve (as a function of wavelength) deviates from the normal psychophysical photopic curve in the blue region of the spectrum. One possible explanation of this deviation is Rayleigh scattering, but this interpretation seems inconsistent with a report by Armington & Schwab (35) that this deviation is decreased in night-blind individuals. This suggests that the  $x$ -wave may be partially scotopic or that a blue system is linked in some way with the scotopic system and shows itself in the night blind and in the retinographic measures of sensitivity, but is not reflected in the psychophysical measurements.

Working with flickering stimuli at low levels of illumination, Dodt (36) obtained a series of regular waves which fuse at about 11 to 20 c.p.s. At intermediate intensities, both photopic and scotopic waves are present, but they fuse at different frequencies. Above 20 lux, a complex wave pattern is exhibited whose exact form depends on intensity and which fuses somewhere between 25 and 70 c.p.s. Dodt & Heck (37) studied the changes in the electroretinal response to flicker in various stages of light and dark adaptation. Using decerebrate cats and frogs, they found that the retinographic cff was lower in the dark adapted eye than in the light adapted eye. They report a positive relation between the duration of dark adaptation and the duration of the initial nonoscillatory part of the ERG. The photopic system yields smaller flicker potentials, but these can oscillate at higher frequencies than scotopic potentials. These same authors have shown that the response of the pure rod eye of the Gecko has most of the characteristics of "mixed-retina" responses (e.g., the  $a$ -,  $b$ -, and  $d$ -waves), but differs in its response to flicker; it fuses for all frequencies above 20 c.p.s. (38).

The retinal potential in *Citellus* is elicited only at high intensities, is not altered in shape by adaptation, and shows a marked off-effect [see, e.g., Vilter (39) and Bornschein (40)]. Vilter (41) has also demonstrated that the retina contains a high density of cones, no rods, and an extremely high density of bipolar and amacrine cells. In fact, the number of bipolar cells exceeds the number of photoreceptor cells by a factor of almost two.

Additional evidence on the complexity of the  $b$ -wave and Granit's  $P_{II}$  component has been presented by Cornu & Gonella (42, 43). Based upon the action of strychnine and the effects of electrical stimulation while the eye is under the influence of strychnine, the authors conclude that both the  $b$ - and  $d$ -waves may be separated into at least two distinct parts.

*Nerve fiber recording.*—The study of the compound eye of lower organisms continues to outline some of the possible mechanisms of action in visual systems. Burtt & Catton (44) have attempted to localize some of the sources of electrical activity in the compound eye of the locust. By inserting a microelectrode into the compound eye, they found that the illumination potential reverses its sign at an electrode depth of 0.5 to 1.0 mm. and that

spike activity is sharply localized, becoming recordable at 1.0 mm. and ceasing at depths of 1.5 to 2.0 mm. The less common oscillatory and spontaneous potentials are not sharply localized in depth. In a second article Burtt & Catton (45) studied the activity of the two lateral compound eyes and the three simple eyes, or ocelli, of the locust. The lateral eye responded to movement with an angular displacement threshold of the order of  $0.3^\circ$ . On the basis of their data they estimate the field angle of a single ommatidium to be about  $20^\circ$ . Since the angular inclination of adjacent ommatidia is about  $2.5^\circ$ , this means that there is extensive overlapping of the visual fields and that many ommatidia are stimulated by a point source of light in the visual field.

Sensitivity curves of a single ommatidium in the crab as a function of angular orientation of the stimulus have been reported by Waterman (46). Maximum sensitivity occurs within an angular range of  $10^\circ$  to  $20^\circ$  off the optical axis of the ommatidium, but responses can be obtained to stimuli as far as  $60^\circ$  to  $80^\circ$  off center. Since the angular inclination of adjacent ommatidia in the crab rarely exceeds  $15^\circ$ , and can be as small as  $4^\circ$ , this again indicates the overlap of ommatidial fields. The effect of polarization, as well as direction, on the sensitivity of a single ommatidium has been investigated by Waterman (47). The data suggest that polarization makes little difference if the light is normally incident, i.e., on the optical axis of the ommatidium. If the stimulus is off this central axis, then the response is less for all planes of polarization and is a function of the plane of polarization. Waterman discusses some of the possible mechanisms for this differential response to polarized light.

In about 70 per cent of the nerves studied, Waterman & Wiersma (48) noted a one-to-one correspondence between the number of ommatidial facets stimulated and the number of active fibers in a nerve bundle. They present the distribution of fiber sizes in the optic nerve and discuss the correlations between ommatidial structure and fiber size distribution. Their results seem to confirm the data of Hartline, Wagner & MacNichol (49), based on microelectrode recording, that the nerve activity recorded in the single fiber work on *Limulus* is a result of the action of the eccentric cell and its associated nerve.

Some of the complexities of visual function that are usually ascribed only to the vertebrate retina have been convincingly demonstrated and studied in the compound eye by Hartline & Ratliff (50). They have shown that the response in a single fiber attributable to one stimulus can be inhibited by stimulating a nearby receptor. This inhibition depends on the area and intensity of the inhibiting stimulus and the distance of the inhibiting receptor from the receptor being inhibited. In addition the inhibiting receptor is, itself, subject to inhibition and, with the proper arrangement of test areas, it is possible to show a phenomenon of disinhibition. This is illustrated in the following sequence: (a) stimulus A is presented and activates the fiber from

which a record is being taken, (b) stimulus B when presented decreases the activity of the fiber, (c) stimulus C, closer to B than A, inhibits B more than A and thus releases A from some inhibition, increasing the activity in the recorded fiber over that shown for A and B together. It is tempting, of course, to use results of this sort to conceptualize some of the problems that have long interested researchers in vision, for example, simultaneous contrast, Mach bands, etc.

An experiment by Barlow, FitzHugh & Kuffler (51) emphasizes the diversity of changes in nerve activity that result from changes in adaptation. For example, they found that adaptation changed the organization of the receptive fields of single retinal units in decerebrate cats. A general result of adaptation was that the time characteristics of the nerve response changed, the units becoming slower in the dark. Additional data on ganglion cell activity in the cat retina come from an experiment by Motokawa & Ebe (52). Following antidromic bombardment, sensitivity (measured by recording nerve activity in response to light) was lowered to about 50 per cent of its normal value and the duration of this phase of reduced sensitivity varied with the dominant wavelength of the test stimulus. These results seem to support Motokawa's earlier conclusions that wavelength effects show up in the temporal pattern of the retinal process.

Mueller (53) has presented a theory of the peripheral visual mechanism that deals with such quantitative characteristics of the single fiber response as the latency of response, number of impulses in a short burst, initial frequency of nerve responding, etc. The formulation provides a simple mechanism by which a disproportionately small yield of activity is obtained at high intensities without appealing to any changes in the absorption constants of the visual system. Small changes in the time characteristics, such as might occur in adaptation, could account for the changes in efficiency during adaptation.

## PSYCHOPHYSICAL MEASUREMENTS

### ADAPTATION

Two experiments by Bartlett & MacLeod (54, 55) deal with the variation in reaction time for different states of adaptation. In the first study they recorded reaction time as a function of the luminance of the test stimulus and the adapting field. For a given field brightness, the brighter the test luminance, the shorter the latency; for a given test luminance, the brighter the field luminance, the longer the latency. In the second study they report the changes in reaction time during dark adaptation, following different conditions of preadaptation. In general, the reaction time decreases during the course of dark adaptation.

Mote (56) obtained 24 dark adaptation curves on each of three subjects and analyzed the intraindividual variability from curve to curve.<sup>7</sup> For two

<sup>7</sup> Wertheimer (57) has also reported on day to day changes in visual thresholds.



of the subjects, variability first decreases, then increases, passes through a maximum at about 8 min., and then decreases again. Thus, the variability seems to follow the slope of the dark adaptation curve. The third subject shows small changes in variability with repeated testing and coincident with this these dark adaptation curves may be characterized by smaller changes in slope, with, for example, a less pronounced "rod-cone break" than that manifested by the other two subjects. The location of the "break" in the dark adaptation curve has been studied by Wolf & Zigler (58) as a function of the brightness and exposure time of the preadapting stimulus. Using a square test field,  $2^\circ$  on a side, and an 0.04 sec. exposure, they measured dark adaptation following preadapting stimuli ranging from 7.5 sec. to 16 min. in duration and 0.11 to 1510 m.L. in luminance. The time of the "break" was found to be a linear function of the logarithm of the energy in the preadapting stimulus, but this function has a different slope when the energy is manipulated with the time dimension than is the case when luminance is varied.

In an attempt to elucidate some of the problems of cone function, Auerbach & Wald (59) have studied dark adaptation to different test wavelengths following adaptation to different spectral regions. After adaptation to either white light or red-orange, orange, yellow or blue lights, the threshold for a  $1^\circ$  test field, presented  $6^\circ$  in the periphery and having a dominant wavelength at either 621  $m\mu$  or 436  $m\mu$ , was determined as a function of time. Several determinations were also made using test wavelengths of 405, 436, 492, or 546  $m\mu$ . In general, the results show that adaptation to red light reduces the sensitivity in the region of the spectrum beyond 500  $m\mu$  for the early stages of adaptation (1 min.); the normal values are reached by 10 min. after the onset of dark adaptation. This depression in the red leaves a relatively prominent peak sensitivity in the blue end of the spectrum (about 440  $m\mu$ ). Adaptation to blue light depresses sensitivity more uniformly over the spectrum but specifically seems to eliminate the usual hump in the blue region.

An experiment by Arden & Weale (60) has raised a number of points that bear on our conceptualization of adaptation and rod-cone function. They measured dark adaptation curves to two foveal stimuli ( $2.7'$  and  $15'$  in diameter) and two peripheral stimuli ( $2.7'$  and  $7^\circ$ ). The dark adapted threshold for the smallest field ( $2.7'$ ) was approximately the same in the fovea and the periphery; the comparative data of the  $2.7'$  and  $7^\circ$  fields in the periphery show that the integrating power of the eye changes in adaptation. The combination of the equal foveal and peripheral sensitivity to very small fields and the change in integration in dark adaptation suggest that the usual difference in threshold in the fovea and periphery may be attributable to the integration or summation action for larger areas, rather than to differences in sensitivity of individual sense cells. These findings are related to the results of Brink & Bouman (61) indicating that light adaptation decreases the time and distance over which retinal interaction occurs. Bouman (62) discusses



some of his own work and some related experiments in the context of the "two-quantum" hypothesis and emphasizes the problem of temporal and spatial integration as revealed by the two-flash experiments and studies with moving targets. The "two-quantum" formulation of van der Velden & Bouman (63) has been criticized by Pirenne & Marriott (64) on the basis of data showing the lack of uniform sensitivity over the range of test areas used in the former's threshold experiments.

The work of Arden & Weale and that of Brink & Bouman fit into a growing body of data that is gradually molding a specific set of alternatives to the set of theories, long inadequate, that attribute changes in sensitivity to changes in the absorption fraction of a visual pigment. We have already alluded to the experimental measurements of Campbell & Rushton and of Rushton *et al.*, to the computations of Wald, and to Mueller's theoretical treatment of the temporal distribution of impulses in the response of single optic nerve fibers, all of which emphasize this problem. An experiment by Mueller & Wilcox (65) on probability of seeing functions for near instantaneous visual thresholds partially supports this development. For 14 levels of adapting luminance, they determined the probability of seeing a stimulus (30' of arc in diameter) 0.2 sec. after the cessation of the adapting stimulus. The changes in threshold that accompany the lower levels of adaptation are correlated with changes in the slope of the psychophysical function in a manner predicted by the quantum argument of Hecht, Schlaer & Pirenne (66). At higher levels of adaptation, the slope of the psychophysical function is constant, and the simpler forms of the quantostatistical theory fail.

#### INTERMITTENT STIMULATION

Landis (67) has reviewed some of the factors that influence flicker fusion thresholds. Variables such as luminance, area, adaptation, exposure time, wavelength, light-dark ratio, waveform, physiological conditions, drugs, etc., are discussed. He also reviewed (68) 28 articles by Crozier and his colleagues (Wolf, Zerrahn-Wolf, Holway) on flicker vision.

One experimental problem that has not received its share of consideration in the vast literature of visual flicker is that of differential sensitivity to flicker. Experiments by Mowbray & Gebhard (69) and Schwarz & Wintzer (70) present recent data on this problem. Mowbray & Gebhard measured the difference limens for intermittent white light at 16 frequencies ranging from 1 to 40 c.p.s. The average deviation of the settings at each of the reference frequencies, when plotted against the reference frequency, shows a minor peak between 0 and 10 cycles and a major peak between 20 and 30 cycles. The average deviations are less than 0.6 c.p.s., and most of them are below 0.4 c.p.s. The  $\Delta f/f$  ratio has values of the order of 0.03. The authors offer these data as evidence that the eye is better at discriminating temporal patterns than has commonly been assumed.

A different way of analyzing the data from experiments using various light-dark ratios has been described by Dzn (71). He considers first the Fourier analysis of the amplitude-time function associated with different light-dark ratios and represents this analysis by the ratio of the amplitude of the fundamental to its harmonics. Dzn found that plotting this ratio as a function of cff yields a curve that is the same for different light-dark ratios but differs for different states of adaptation. The analysis stresses a point not revealed by most flicker fusion curves but consistent with other data using intermittent stimulation, namely, that the visual system seems to be maximally "tuned" to frequencies between 7 and 10 c.p.s. A plot of the fundamental-harmonic ratio against cff for low intensities yield a monotonically decreasing function; for higher adapting intensities, this function first increases, passes through a maximum near 7 to 10 c.p.s., then decreases more and more rapidly.

Thomas (72, 73) has presented extensive data on the effect of intensity and phase differences in the two eyes on binocular flicker fusion thresholds. For a stimulus of fixed luminance in the right eye, he measured cff for various luminance levels in the left eye over a range of approximately 6 log units. Two stimulus sizes and two retinal locations were used, and complete cff-intensity functions were obtained when the stimuli to the two eyes were in and out of phase. In general, there is a subtractive effect of the dimmer of the two stimuli on the brighter for the larger of the two areas; the effect is less pronounced or absent for the smaller stimulus. The binocular cff for the in-phase condition was higher than the binocular out-of-phase condition. These differences were small, less than that expected from doubling the luminance for a single eye, and appeared to be independent of luminance over the 6 log unit range studied.

A detailed examination of the dependence of flicker fusion threshold on the area of the test stimulus was performed by Kugelmass & Landis (74). Thirty-six stimulus sizes, ranging in diameter from  $1.27^\circ$  to  $14.6^\circ$ , were presented at each of five different levels of luminance. Over the range of areas investigated, a plot of cff against log area yields an increasing, monotonic, decelerated curve.

Ricciuti & Misiak (75) feel that the use of the method of constant stimuli for determining the cff yields lower intraindividual variability, yet results in better discrimination among different observers.

Flemming (76) and Wachholder & Arnold (77) have shown that sympathicomimetic drugs and sympathetic stimulants increase cff, while their parasympathetic counterparts decrease cff. Landis & Clausen (78) have failed to find any effect of lysergic acid and mescaline on cff.

When cortical potentials and psychophysical data were recorded within an hour of each other, Chyatte (79) found that the cff correlated .58 with the average of the alpha rhythm peaks and .86 with the fraction of the total recording time during which there was a detectable alpha rhythm.

## SPECTRAL SENSITIVITY AND COLOR VISION

Spectral response curves were measured by Motokawa & Isobe (80) by determining the electrical phosphene threshold following exposure to colored lights. Earlier papers by Motokawa report that the threshold rises to a maximum, then decreases following visual stimulation, and that this maximum occurs at different times for different colored lights. In this study Motokawa & Isobe measured the electrical phosphene threshold at the optimal times for each color in order to obtain information on different color receptors. Spectral response curves were determined for normal, deuteranopic, protanopic, deuteranomalous, and protanomalous subjects with this technique. They also measured hue discrimination curves and show the extent to which these may be predicted from the previously determined spectral response curves.

The luminosity curves of 7 normal subjects, 5 deuteranopes, and 5 protanopes were determined by Graham & Hsia (81). The average curve for the protanopes shows a loss of luminosity in the red end of the spectrum, and the rise at 610  $m\mu$  typical of normal subjects is partially or completely removed. The average curve of the deuteranopes shows a loss in luminosity in the short end of the spectrum, from 415 to approximately 530  $m\mu$ , and the blue "hump" typical of the normal curve decreases or disappears. Graham & Hsia also present data for a unilaterally color blind subject; a normal luminosity curve was obtained in the right eye, while the curve for the left eye showed a loss in luminosity below 530  $m\mu$ .

The general question of the correlation between the "effectiveness" of a colored stimulus measured at absolute threshold and "effectiveness" measured by some suprathreshold matching procedure is raised in an experiment by Chapanis & Halsey (82). They analyzed the luminances of 342 colored stimuli matched in "brightness" on the basis of subjects' equality judgments. Although the authors point out some limitations to their procedure for equating brightnesses, they feel their results show that for colors of equal judged brightness, most saturated colors require less luminance than desaturated colors.

The magnitudes of various monochromatic stimuli required to eliminate the "chromaticness" of four reference stimuli (red, yellow, green, and blue) were determined by Jameson & Hurvich (83). For each reference stimulus they presented a family of cancellation wavelengths, separated by 10  $m\mu$  intervals, and measured the amount of each cancellation stimulus that would eliminate the color of the reference stimulus. From the relative energies of the cancellation stimuli they derive chromatic valence curves. The authors then predict the outcome of a wavelength discrimination experiment from the chromatic valence curves on the assumption that the discrimination of wavelength depends on the ratio of chromatic to achromatic components of the response to light.

Halsey & Chapanis (84) obtained chromaticity-confusion contours by

means of a procedure that entailed having the subject select all the stimuli in a matrix of colored stimuli that matched some reference stimulus. Each standard or reference stimulus was then plotted as a point on a C.I.E. diagram, and all of the stimuli selected as matches for it were plotted around it. The percentage of times that such a match was made was recorded and contours were drawn to include stimuli that were matched on a certain proportion of the trials. There was an approximate agreement between their results and the confusion contours reported by MacAdam (85) based on threshold data in a simpler viewing situation.

Granit's microelectrode work on the cat has stimulated two behavioral studies on color vision in this animal. Both of these experiments, one by Gunter (86), the other by Meyer, Miles & Ratoosh (87), fail to find any evidence for color vision in the cat, even when discrimination training was continued for 2000 trials.

Weale (88) points out that the term "achromatopsia" is unnecessarily vague because it fails to distinguish the cone monochromat which has an approximately normal photopic visibility curve and the rod monochromat, whose visibility curve is closer to the normal scotopic curve and which exhibits decreased visual acuity. Questions of fact as well as of nomenclature are raised by Baumgardt & Magis (89) on the basis of data for a subject who was an achromat at low and medium levels of luminance and whose luminosity curve was displaced 25  $m\mu$  toward the blue end of the spectrum, but who gave protanopic color responses at very high luminances.

#### COLOR THEORY

From curves based on the color mixture data of the C.I.E. standard observer, Hurvich & Jameson (90) develop a quantitative model of color vision by using the notion of opponent colors suggested by Hering. On the assumption of three pairs of opponent processes, they attempt to organize the luminosity data, saturation discrimination data, the Bezold-Brücke phenomenon, and the color vision of protanopes and deuteranopes. Schelling (91) has also argued for more than three basic excitation functions in treating color vision. He attempts to determine the minimum number of Gaussian functions in wavelength that will yield the  $x$ - $y$ - $z$  functions of the C.I.E. system. By means of a trial-and-error method he concludes that four curves (each very close to Gaussian curves in the range from 0.01 to 0.99) will approximate the  $x$ - $y$ - $z$  curves and considers some of the consequences of assuming that the "real" excitation curves are exactly Gaussian.

Walls (92) has outlined what he calls a branched-pathway schema for color vision, which represents an elaboration of some theoretical notions developed in an earlier monograph by Walls & Mathews (93). The discussion deals mainly with color blindness and places heavy emphasis on certain genetic characteristics of the color blind problem.

Wyszecki (94) has provided a simple and coherent geometrical interpre-

tation of the algebraic formulation presented by Helson, Judd & Warren (95) for the changes in color perception under differently colored light sources. The argument is first developed for the special case considered by Helson *et al.* and then the more general features of the formulation are discussed.

#### CONTRAST AND "GLARE"

We have already discussed some of the measurements of scattering within the eye and described a direct demonstration of spatial inhibition at the single fiber level. A number of behavioral studies measuring spatial contrast come in direct contact with these problems. Alpern (96) and Fry & Alpern (97, 98) determined the effect of an inducing field (a) in the right eye on a test field (b) in the same eye by recording the luminance of a comparison figure (c) in the left eye that is required for the subject to say that (b) and (c) are equal. The contrast effect is greater the higher the luminance of the inducing field and the nearer the inducing field is to the test field in the same eye. A theoretical treatment of the contrast problem is given in terms of a combination of the physics of the glare source and the photochemical activity in the receptor.

The possibility that the effects of any "glare" source are attributable to scattering can be tested by working with different wavelengths, since the scattering function changes as a power function of the frequency of the stimulating light. Wanderer (99) has investigated this problem, using differential sensitivity as a measure of the effect of glare, and found that a blue glare source has a greater effect than a red one.

#### MOVEMENT

Hall & Earle (100) extend the observations of an earlier report that if a metronome beat is used to turn on first one light, then a second, the path of the apparent movement is reported as curved. A number of new observations are reported, among them the fact that this apparently curved movement is much less likely to be seen if the lights are placed vertically than when placed horizontally, and that if curvedness is reported in the former situation, its magnitude is judged as less extensive.

Gibson (101) has raised the general questions of how we perceive the motion of objects and how we perceive our own movement in a stable environment. After considering some of the apparatus and results of "movement" experiments, he offers two general hypotheses: (a) any regular transformation of a bidimensional image tends to yield a tridimensional motion in perception; (b) any transformation of the total retinal image, as distinguished from a part image within it, tends to yield an experience of a movement of the observer. In both cases the kind of movement depends on the kind of transformation. Some examples of spatial transformations are given; for instance, the continuous transformations of translation, rotation, and projection, and some discontinuous transformations are discussed. Some

illustrations of the perceptual correlates of these transformations are given.

The autokinetic phenomenon has been studied by Chaplin (102), Edwards (103, 104), and Luchins (105). Edwards and Luchins have shown that the latency of the report of movement increases with the size and luminance of the stationary stimulus while the "amount" of movement reported decreases under the same circumstances. Both authors discuss the variety of verbal reports obtained.

Bridges & Bitterman (106) describe an apparatus for studying the autokinetic phenomenon by treating the movement as one might treat "real" movement, that is, requiring the individual to track it by a null method of keeping the source in its original position. Conklin (107) feels that the errors caused by the interaction of real movement (which these tracking adjustments involve) and the illusory movement, plus the disadvantages of using compensatory tracking at low illuminations and high rates of movement, argue against the method. He suggests that a more suitable procedure might be to train the subject to follow a light stimulus at high levels of illumination with real moving targets, and then test him in the autokinetic situation.

#### DISCRIMINATION OF DEPTH AND DISTANCE

This year has furnished several reviews of binocular vision. Fischer & Wagenaar (108), in a contribution to the Netherlands Symposium on Strabismus, have summarized some problems of spatial localization and, more specifically, have discussed the various methods of examining stereoscopic vision.<sup>\*</sup> A survey of some of the theories of binocular vision and of some of the data relating to them has been made by Charnwood (110).

Sachsenweger (111) has re-examined the relation of depth discrimination to level of intensity and reports that a double logarithmic plot of these two variables yields a linear function. Rady (112) found superior stereoscopic acuity when the subject could alternately fixate on the standard and comparison targets than when he fixated on only one; under either condition stereoscopic acuity decreases with increasing separation of the two targets.

The effect of the angular overlap of the images to the left and right eyes in a stereoscopic view has been studied by Ogle (113). The results show that the variability of depth settings decreases as the angular overlap of the two views increases. For a short exposure time (0.2 sec.) it was possible for the subjects to see "depth" when the stimuli did not overlap; for a longer continuous exposure, the subjects rarely saw depth.

Ivanoff & Bourdy (114, 115) have shown that binocular convergence reaches a fixed level at dim illuminations which is independent of object distance and, for emmetropes, is of the order of 2 diopters. The data indicate

<sup>\*</sup> This symposium contains a number of other articles that cannot be discussed here because of space limitations, but which may be of interest to research workers in vision, e.g., Roelofs' article (109) on optokinetic nystagmus.

that the myopia commonly encountered at low levels of illumination is related to nocturnal binocular convergence. These experiments add to the evidence that at very dim illuminations the visual system becomes a less variable optical system.

Gruber (116) has analyzed some of the relations existing between perceived size and perceived distance by having subjects make "equal distance" and "half distance" settings at six distances, and by having the same subjects make size matches with the standard stimulus half as far, or at the same distance as the variable stimulus. When the variable stimulus was placed at twice the standard distance, the variable size setting was made larger than the standard. When the variable stimulus was adjusted to "half" the distance of the standard, the subjects made settings beyond the geometrical midpoint. However, the correlations ( $-.10$  to  $+.24$ ) indicate little or no relationship between "half-distance" judgments and size estimates. The percentage error for half-distance judgments was found to be approximately constant at 10 per cent over the distances used, whereas the percentage error for size ranged between 4 per cent and 23 per cent.

The geometry of the Pulfrich phenomenon has been outlined in general algebraic terms by Weale (117), and a number of specific solutions have been discussed. He has shown that the generalized "seen" path of the Pulfrich object is an ellipse which reduces to a circle under certain viewing conditions, e.g., increasing the observation distance. Weale (118) has also considered some of the consequences for the geometry of the Pulfrich phenomenon of the fact [reported by Robinson (119), Trincker (120), and others] that the apparent size of an object depends on its luminance and, therefore, that the apparent size of a Pulfrich object is different for the two eyes.

#### DISCRIMINATION OF LOCATION AND POSITION

Several papers treat the problem of correctly identifying the position of a stimulus in a two dimensional field. Attneave (121) required his subjects to reproduce from immediate memory the location of a stimulus in a circular field. The only guide line provided was the circumference of the circle. From Attneave's data it appears that the subjects divide the circle into four distinct quadrants and displace all points toward the middle of the quadrant in which the stimulus appeared. Leibowitz, Myers & Grant (122) studied the ability of human subjects to estimate the radial position of a stimulus as a function of the luminance and exposure time of the stimulus. The percentage of stimuli reported was found to increase with the luminance, whereas the mean localization error does not, suggesting that all targets seen are equally well localized. Related to the two previous experiments is a discussion by Klemmer (123) of the amount of information carried by the angular and radial components of a polar presentation in two dimensions. The theoretical discussion is accompanied by a report of some experimental re-



sults on estimation of location and a consideration of some of the practical consequences of the problem.

Pollack & Klemmer (124, 125) have shown that the ability of a human subject to localize an oblong figure in one of eight positions in a row depends on its position; there is greater response uncertainty for the middle than for end positions. Performance improves with increase in exposure time and when there are no "noise dots" in the surrounding field. According to Eriksen (126), the search time required to locate a fixed number of stimuli in a square field increases with the number of "irrelevant" signals present, as well as with the number of partitions into which the square field is subdivided.

#### SIZE AND SHAPE

We referred above to an experiment by Robinson showing that the apparent size of an object increases with the luminance of the object, and one by Trincker who found a linear function relating the apparent diameter and luminance ratio of the variable and standard stimuli. Brown (127) has reported an illusion of fluctuating apparent size which he describes in terms of changes in pupil size.

Adams (128) investigated the change in the apparent size of a figure in a stereoscopically presented picture as a function of the separation of the pictures presented to the two eyes. When the left and right eye views are crossed, the target has a smaller apparent size than when they are uncrossed and the quantitative function for 13 magnitudes of decentration is a steadily increasing one.

The figure-ground problem has been studied in a single geometric context by Künnapas (129), who found that the length of a line that appears equal to a reference line is a linear function of the logarithm of the side of the square on which the line is drawn.

Krauskopf, Duryea & Bitterman (130) and Bitterman, Krauskopf & Hochberg (131) have contributed some quantitative information to the difficult problem of form discrimination and its relation to threshold data for differently shaped objects. They determined thresholds for detecting a stimulus and for reporting its form, using a number of common geometrical figures (circle, square, cross, T, etc.). The difference between "form" and "light" thresholds and between different figures shows itself in the functional dependencies on variables such as length and area. For example, the form threshold was a decreasing function of the length of the extension for the cross, the X, and the rectangle; the light threshold was constant over these same ranges of the variable length, as was the form threshold for the triangle. The form and light thresholds showed the same functional dependence on area, although the magnitudes of the thresholds were higher for detection of form than of light. The authors develop a qualitative theory involving the notion of a diffusion process that makes specific suggestions for some of the

false prerecognition responses concerning the form of a stimulus.

The importance of guarding against overextrapolation from one type of behavioral measure to another because the same kinds of visual stimuli are involved has been touched on by Adams *et al.* (132). They used 11 measures of "discriminability" for a set of visual figures; some of these were threshold measures, some were suprathreshold, some were time measures, and some were learning measures. On the basis of the results from these separate measures, they draw a distinction between a visibility-type task and a legibility-type task.

Admittedly distinctions such as light and form or visibility and legibility are vague and presumably will not terminally rest with whether the verbal response is "yes" or "circle," or whether one classifies the response as either "yes" or "no," or measures its latency. However, the analysis of problems of the sort touched by the last three experiments should be of theoretical interest of the psychologist concerned with perceptual or discriminative functions.

The ability to detect differences in shape of a nonsense figures has been shown by Arnoult (133) to depend on the angular orientation of the figure. Both the percentage error and the latency data show that performance is best when the figures are of the same orientation, and that it passes through a minimum at 90° rotation.

Langdon (134, 135) finds that the cues for shape that are derivable from the motion of an object make a significant contribution to the judgment of shape and that the amount of this contribution depends on the speed of rotation of the figure. The effect of this motion depends on the "equivalent space" in which the figure appears, i.e., if the figure is rotating in an induced space of the sort furnished by the Ames-type demonstration the results will be different from those for a comparable movement in an "euclidian" space.

#### FIGURAL AFTER-EFFECTS

The quantitative importance of the exposure time of the test figure on the magnitude of the measured after-effects of an inspection figure has been demonstrated experimentally by Krauskopf (136). Over the range from 0.3 to 1.5 sec., the magnitude of the after-effect was a decreasing function of the exposure time. Data by Hochberg & Triebel (137) indicate that the magnitude of the figural after-effect phenomenon depends primarily on the luminance of the figures involved and not on the dominant wavelength of the stimuli.

Some of the theoretical features of figural after-effects have been examined by Wertheimer & Wertheimer (138), Wertheimer (139), and Marquart (140). On the basis of a set of assumptions that form a physiological-like model, Wertheimer & Wertheimer make a number of predictions concerning the phenomena of figural after-effects. Preliminary checks indicate that these predictions are "essentially" correct. One of the empirical checks is reported

in a paper by Wertheimer in which he found that male schizophrenics show smaller figural after-effects from visual stimuli than do normal controls. Marquart comes out with a somewhat less optimistic evaluation of Köhler's satiation theory of figural after-effects on the basis of results using complex stimulus figures.

#### OTHER CONSIDERATIONS

Two quantitative experiments on Mach bands have appeared. Fiorentini, Jeanne & Toraldo (141) attempted to measure the brightness of Mach bands that appear at points of rapid change in the luminance gradients by determining the thresholds for the detection of an added stimulus as a function of its position along a luminance gradient. The technique of measuring threshold increments across this figure yields values that are in qualitative agreement with the appearance of the figure. One notable result is that the thresholds are higher throughout most of the region of changing luminance than they are for a uniform part of the figure that has a higher measured luminance. This latter finding may be related to the data of McCollough (142) showing that the width of the Mach bands increases with the luminance at the point of maximum change in luminance and decreases with an increase in the rate of change of luminance.

The Haidinger effect refers to the dependence of sensitivity of the central retina on the polarization of the incident light. Naylor & Stanworth (143) studied this effect by using a flicker method in which two polarized sources, rotated 90° with respect to each other, were alternated and the intensities required to stop flicker were determined as a function of the wavelength of the stimulus. The effect is attributed to the orientation of macular pigment, although the region of the spectrum (below 430  $m\mu$ ) that would provide the clearest test of the alternative theories was not tested because of apparatus limitations.

Miles (144) has reported a method of plotting Maxwell's spots and the results of some measurements. He alternately presented colored and neutral filters, the colored filter transmitting below 430 and above 660  $m\mu$  but having near-zero transmission between these extremes. The most common result shows three concentric circular areas with outer diameters of 160', 70', and 32', respectively, and attempts are made to correlate these areas with retinal structure. This problem has also been investigated by Isobe & Motokawa (145) using the technique of measuring sensitivity to electrical stimuli following brief photic stimulation. They offer support for an hypothesis advanced by Walls that the pattern of rings is related to the distribution of different receptors.

Prentice (146) has shown that the results from experiments of the sort performed by Carmichael, Hogan & Walter (147) on "memory" for visual figures depend on the behavioral measure used. They had reported that what subjects will draw when asked to reproduce visual forms depends on the

verbal label given at the time the visual form was inspected. When Prentice measured the memory for such labelled figures with a recognition measure, he found that most subjects were able to recognize the original figure regardless of the label applied and that when they made incorrect selections the figure selected was no more likely to be in the direction of the label applied at the time of inspection than in the direction of a label never used.

Some concepts of information theory have been used by Attneave (148) as a tool for describing some of the problems of perception. Viewed in communication or information processing terms, most objects or figures in the environment form stimulus patterns that have large amounts of redundancy. Certain characteristics of the pattern carry more information than others, and an attempt is made to indicate some ways in which Gestalt principles of perceptual organization may be described in informational terms. Ways of describing certain kinds of visual stimuli "economically" are given; the economy is an informational one in that the suggested descriptive procedures are essentially methods of reducing the redundancy. Attneave's treatment of the "information carrying" parts of a stimulus figure and the emphasis on contour has its correlate in many discussions of visual mechanisms. A report this year by Walls (149) on the "filling-in" process deals with a related problem. The "filling-in" of a scotoma has long been a topic of debate in the visual literature, particularly in connection with the blind spot. The same question is raised by the central scotoma at luminance levels below foveal threshold, and Walls feels that the problem is even more general than this. It is well-known (see also the discussion of Ditchburn above) that optically stopping the small oscillatory eye movements will cause many stimuli to adapt out and completely disappear. Walls argues that the filling-in operation must be active for many stationary stimuli that are larger than the tremor movements of the eye, since the centers of such stimuli probably become ineffective as a result of local adaptation. These experimental and theoretical papers provide part of the background for saying that the edges of stimulus figures carry most of the information that is important in specifying the neural output of the visual system.

#### PERCEPTUAL FUNCTIONS AND SOME PAST HISTORY AND PERSONALITY VARIABLES

Research continues to flourish in the area denoted as perception and personality. The need for unifying some of the concepts of learning and perception has already been stressed in the literature discussing the role of word frequency on recognition threshold. Recently, King-Ellison & Jenkins (150) have attacked this problem by selecting ten paralogues and presenting them with different frequencies in a list. Each subject read through the list, pronouncing and spelling each word. Recognition thresholds were then determined and a correlation of  $-0.99$  was obtained between mean exposure

time and the logarithm of the frequency of presentation. The median individual correlation was  $-.43$ . When the symbols were considered in terms of the amount of information carried, a linear relationship existed between the duration threshold and the amount of information received. This is related to a finding by Miller, Bruner & Postman (151), for letter sequences representing four different orders of approximation to the English language, that the per cent of letters correctly placed by a subject increased with the exposure time and with the order of approximation to English; correcting the letter sequences for their information content showed that the letter recognition of the higher orders of approximation was attributable to the decrease in information carried by the symbols.

A demonstration of the information provided by a near threshold exposure of a nonsense syllable is given by Murdock (152). After the presentation of one of 10 possible syllables, the subject is asked to order the list on the basis of his estimate of the likelihood that a given syllable corresponds to the one just exposed. Each syllable could appear in one of 10 positions in such a ranking. Looking only at those rankings in which the first estimate was wrong, the location of the "correct" syllable was not equally likely to appear in the other nine positions, but was more likely to be in the first half of the rankings.

Postman & Conger (153) emphasize that the frequency of verbal usage, and not frequency of occurrence in printed material, is the important variable in recognition thresholds. A significant correlation exists between frequency counts of words and recognition thresholds, but no such correlation between frequency of trigrams (three letter sequences that appear in words) and recognition thresholds can be demonstrated.

Neisser (154) has clearly shown the specificity of the threshold changes in this type of experiment. Subjects were allowed to study a list of 10 nonsense words for 1 min.; then the recognition threshold for five control words, five words from the studied list, and homonyms of the other five words on the list were measured. The thresholds for the homonyms and the control words were the same and both of these groups of words yielded higher thresholds than did the original words on the list.

Lysak (155), Reece (156), Rosen (157), and Smith & Hochberg (158) have studied the effects of shock when paired with either the stimulus word, the verbal response word, or both. For example, Rosen found that, if the subject could avoid shock by "correctly perceiving" the stimulus, discrimination was better than it was if shock were unavoidable. Reece reported that an escapable shock yielded lower thresholds than a nonescapable shock, and that no differences existed between a group that had escapable shock and one that had no shock.

The Murdock experiment shows again that the results in a psychological experiment will depend on the behavioral measure used. Rosen's experiment is one on avoidance conditioning and discrimination and reminds us that the

threshold is a statistical concept that involves training as one of a large number of parameters. The fact that many of these variables produce small magnitudes of change frequently leads us to ignore them. For example Berger & Mahneke (159) have recently shown that fatigue or response inhibition can operate to change the flicker and acuity threshold by 10 to 30 per cent within a 1 hr. session, and that a 10 min. rest period will yield a partial recovery. Compared with the effects of such variables as adaptation or region of the retina stimulated, these magnitudes may be small; compared with the effects of some of the variables encountered in recent studies of organism and past history variables, these changes will appear large.

## LITERATURE CITED

1. Graham, C. H., *Office of Naval Research, Tech. Rept. ONRL-71-53* (1953)
2. *Colloquio sobre Problemas Opticos de la Vision* (Union International de Physique Pure et Appliquee, Madrid, Spain, 150 pp., 1953)
3. Granit, R., *Receptors and Sensory Perception* (Yale University Press, New Haven, Conn., 369 pp., 1955)
4. Allport, F. H., *Theories of Perception and the Concept of Structure* (John Wiley & Sons, Inc., New York, N. Y., 709 pp., 1955)
5. Ittelson, W. H., and Cantril, H., *Perception: A Transitional Approach* (Doubleday & Co., Inc., Garden City, N. Y., 83 pp., 1954)
6. Clausen, J., *Visual Sensations (Phosphenes) Produced by AC Sine Wave Stimulation* (Ejnar Munksgaard, Copenhagen, Denmark, 101 pp., 1955)
7. Boynton, R. M., Enoch, J. M., and Bush, W. R., *J. Opt. Soc. Amer.*, **44**, 879-96 (1954)
8. Ranke, G., *Arbeitsphysiol.*, **15**, 427-47 (1954)
9. Stegemann, J., *Intern. Z. Angew. Physiol.*, **16**, 57-60 (1955)
10. Steinhard, J., *J. Gen. Physiol.*, **20**, 185-209 (1936)
11. Graham, C. H., Brown, R. H., and Mote, F. A., *J. Exptl. Psychol.*, **24**, 555-73 (1939)
12. Young, F. A., and Biersdorf, W. R., *J. Comp. Physiol. Psychol.*, **47**, 264-68 (1954)
13. Cüppers, C., *Albrecht von Graefe's Arch. Ophthalmol.*, **155**, 588-616 (1954)
14. Riggs, L. A., Armington, J. C., and Ratliff, F., *J. Opt. Soc. Amer.*, **44**, 315-21 (1954)
15. Ten Doesschate, G., and Lansberg, M. P., *Ophthalmologica*, **128**, 298-300 (1954)
16. Mackensen, G., and Harder, S., *Albrecht von Graefe's Arch. Ophthalmol.*, **155**, 397-412 (1954)
17. Hodgson, F., and Lord, M. P., *Nature*, **174**, 75-76 (1954)
18. Riggs, L. A., and Ratliff, F., *J. Opt. Soc. Amer.*, **42**, 872-73 (1952)
19. Ditchburn, R. W., *Opt. Acta*, **1**, 171-76 (1955)
20. Crescitelli, F., and Dartnall, H. J. A., *J. Psychol. (London)*, **125**, 607-27 (1954)
21. Dartnall, H. J. A., *J. Physiol. (London)*, **125**, 25-42 (1954)
22. Wald, G., *Nature*, **175**, 390-91 (1955)
23. Collins, F. D., *Biol. Revs. Cambridge Phil. Soc.*, **29**, 453-77 (1954)
24. Denton, E. J., and Pirenne, M. H., *J. Physiol. (London)*, **125**, 181-207 (1954)
25. Hagins, W. A., *J. Physiol. (London)*, **126**, 37 (1954)
26. Campbell, F. W., and Rushton, W. A. H., *J. Physiol. (London)*, **126**, 36 (1954)
27. Rushton, W. A. H., Campbell, F. W., Hagins, W. A., and Brindley, G. S., *Opt. Acta*, **1**, 183-90 (1955)
28. Wald, G., *Science*, **119**, 887-93 (1954)
29. Wald, G., *Am. Scientist*, **42**, 73-95 (1954)
30. Sallmann, L. von, *Arch. Ophthalmol. (Chicago)*, **52**, 604-40 (1954)
31. Armington, J. C., and Thiede, F. C., *J. Exptl. Psychol.*, **47**, 329-34 (1954)
32. Armington, J. C., and Thiede, F. C., *J. Opt. Soc. Amer.*, **44**, 779-86 (1954)
33. Wirth, A., and Zetterström, B., *Brit. J. Ophthalmol.*, **38**, 257-65 (1954)
34. Johnson, E. P., and Cornsweet, T. N., *Nature*, **174**, 614-16 (1954)
35. Armington, J. C., and Schwab, G. J., *Arch. Ophthalmol.*, **52**, 725-33 (1954)
36. Dodt, E., *Experientia*, **10**, 330-33 (1954)
37. Dodt, E., and Heck, J., *Pflügers Arch. ges. Physiol.*, **259**, 212-25 (1954)
38. Dodt, E., and Heck, J., *Pflügers Arch. ges. Physiol.*, **259**, 226-30 (1954)



39. Vilter, V., *Compt. rend. soc. biol.*, **148**, 1786-71 (1954)
40. Bornschein, H., *Naturwissenschaften*, **41**, 435 (1954)
41. Vilter, V., *Compt. rend. soc. biol.*, **148**, 1963-66 (1954)
42. Cornu, L., and Gonella, J., *Compt. rend. soc. biol.*, **148**, 702-5 (1954)
43. Cornu, L., and Gonella, J., *Compt. rend. soc. biol.*, **148**, 1096-99 (1954)
44. Burt, E. T., and Catton, W. T., *J. Physiol. (London)*, **126**, 27-28 (1954)
45. Burt, E. T., and Catton, W. T., *J. Physiol. (London)*, **125**, 566-80 (1954)
46. Waterman, T. H., *Proc. Natl. Acad. Sci. U. S.*, **40**, 252-57 (1954)
47. Waterman, T. H., *Proc. Natl. Acad. Sci. U. S.*, **40**, 258-62 (1954)
48. Waterman, T. H., and Wiersma, C. A. G., *J. Exptl. Zool.*, **126**, 59-86 (1954)
49. Hartline, H. K., Wagner, H. G., and MacNichol, E. F., *Cold Spring Harbor Symposia Quant. Biol.*, **17**, 125-41 (1952)
50. Hartline, H. K., and Ratliff, F., *Science*, **120**, 781 (1954)
51. Barlow, H. B., FitzHugh, R., and Kuffler, S. W., *J. Physiol. (London)*, **125**, 28-29 (1954)
52. Motokawa, K., and Ebe, M., *J. Neurophysiol.*, **17**, 364-74 (1954)
53. Mueller, C. G., *Proc. Natl. Acad. Sci. U. S.*, **40**, 853-63 (1954)
54. Bartlett, N. R., and MacLeod, S., *J. Opt. Soc. Amer.*, **44**, 306-11 (1954)
55. MacLeod, S., and Bartlett, N. R., *J. Opt. Soc. Amer.*, **44**, 374-79 (1954)
56. Mote, F. A., *J. Opt. Soc. Amer.*, **45**, 7-12 (1955)
57. Wertheimer, M., *J. Gen. Psychol.*, **52**, 111-47 (1955)
58. Wolf, E., and Zigler, M. J., *J. Opt. Soc. Amer.*, **44**, 875-79 (1954)
59. Auerbach, E., and Wald, G., *Am. J. Ophthalmol.*, **39**, 24-39 (1955)
60. Arden, G. B., and Weale, R. A., *J. Physiol. (London)*, **125**, 417-26 (1954)
61. Brink, G. van den, and Bouman, M. A., *J. Opt. Soc. Amer.*, **44**, 616-20 (1954)
62. Bouman, M. A., *J. Opt. Soc. Amer.*, **45**, 36-43 (1955)
63. Bouman, M. A., and van der Velden, H. A., *J. Opt. Soc. Amer.*, **37**, 908-19 (1947)
64. Pirenne, M. H., and Marriott, F. H. C., *Opt. Acta*, **1**, 151-55 (1954)
65. Mueller, C. G., and Wilcox, L. R., *Science*, **120**, 786 (1954)
66. Hecht, S., Schlaer, S., and Pirenne, M. H., *J. Gen. Physiol.*, **25**, 819-40 (1942)
67. Landis, C., *Physiol. Revs.*, **34**, 259-86 (1954)
68. Landis, C., *J. Psychol.*, **37**, 3-17 (1954)
69. Mowbray, C. H., and Gebhard, J. W., *Science*, **121**, 173-75 (1955)
70. Schwarz, F., and Wintzer, H., *Pflügers Arch. ges. Physiol.*, **260**, 74-80 (1954)
71. Dzn, H. de L., *J. Opt. Soc. Amer.*, **44**, 380-89 (1954)
72. Thomas, G. J., *Am. J. Psychol.*, **67**, 632-46 (1954)
73. Thomas, G. J., *Am. J. Psychol.*, **68**, 37-53 (1955)
74. Kugelmass, S., and Landis, C., *Am. J. Psychol.*, **68**, 1-19 (1955)
75. Ricciuti, H. N., and Misiak, H., *J. Gen. Psychol.*, **51**, 213-19 (1954)
76. Fleming, K., *Z. Biol.*, **107**, 284-93 (1954)
77. Wachholder, K., and Arnold, H., *Z. Biol.*, **107**, 252-63 (1954)
78. Landis, C., and Clausen, J., *J. Psychol.*, **38**, 211-21 (1954)
79. Chyatte, C., *Genet. Psychol. Monographs*, **50**, 189-226 (1954)
80. Motokawa, K., and Isobe, K., *J. Opt. Soc. Amer.*, **45**, 79-88 (1955)
81. Graham, C. H., and Hsia, Y., *Science*, **120**, 780 (1954)
82. Chapanis, A., and Halsey, R. M., *J. Opt. Soc. Amer.*, **45**, 1-6 (1955)
83. Jameson, D., and Hurvich, L. M., *Eastman Kodak Color Technology Division, Report A-193* (1952)
84. Halsey, R. M., and Chapanis, A., *J. Opt. Soc. Amer.*, **44**, 442-54 (1954)

85. MacAdam, D. L., *J. Opt. Soc. Amer.*, **33**, 18-26 (1943)
86. Gunter, R., *J. Comp. Physiol. Psychol.*, **47**, 169-72 (1954)
87. Meyer, D. R., Miles, R. C., and Ratoosh, P., *J. Neurophysiol.*, **17**, 289-94 (1954)
88. Weale, R. A., *J. Opt. Soc. Amer.*, **45**, 64-65 (1955)
89. Baumgardt, E., and Magis, C., *J. physiol. (Paris)*, **46**, 237-40 (1954)
90. Hurvich, L. M., and Jameson, D., *Eastman Kodak Color Technology Division, Report A-194* (1955)
91. Schelling, H. von, *J. Opt. Soc. Amer.*, **45**, 209-15 (1955)
92. Walls, G. L., *Am. J. Ophthalmol.*, **39**, 8-23 (1955)
93. Walls, G. L., and Mathews, R. W., *New Means of Studying Color Blindness and Normal Foveal Color Vision* (University of California Press, Berkeley, Calif., 172 pp., 1952)
94. Wyszecki, G., *J. Opt. Soc. Amer.*, **44**, 787-92 (1954)
95. Helson, H., Judd, D. B., and Warren, M. H., *Illum. Eng.*, **47**, 221-23 (1952)
96. Alpern, M., *Am. J. Optometry*, **31**, 363-69 (1954)
97. Fry, G. A., and Alpern, M., *Am. J. Optometry*, **31**, 506-20 (1954)
98. Fry, G. A., and Alpern, M., *Illum. Eng.*, **50**, 31-38 (1955)
99. Wanderer, E., *Intern. Z. Angew. Physiol.*, **16**, 2-19 (1955)
100. Hall, K. R. L., and Earle, A. E., *Quart. J. Exptl. Psychol.*, **6**, 112-24 (1954)
101. Gibson, J. J., *Psychol. Rev.*, **61**, 304-14 (1954)
102. Chaplin, J. P., *J. Gen. Psychol.*, **52**, 149-55 (1955)
103. Edwards, W., *J. Exptl. Psychol.*, **48**, 391-98 (1954)
104. Edwards, W., *J. Exptl. Psychol.*, **48**, 493-95 (1954)
105. Luchins, A. S., *J. Psychol.*, **38**, 438-52 (1954)
106. Bridges, C. C., and Bitterman, M. E., *Am. J. Psychol.*, **67**, 525-29 (1954)
107. Conklin, J. E., *Am. J. Psychol.*, **68**, 144-45 (1955)
108. Fischer, F. P., and Wagenaar, J. W., *Documenta Ophthalmol.*, **7-8**, 359-91 (1954)
109. Roelofs, C. O., *Documenta Ophthalmol.*, **7-8**, 579-650 (1954)
110. Charnwood, Lord, *Brit. J. Physiol. Optics*, **11**, 65-72 (1954)
111. Sachsenweger, R., *Albrecht von Graefe's Arch. Ophthalmol.*, **155**, 496-517 (1954)
112. Rady, A. A., *Nature*, **175**, 305-06 (1955)
113. Ogle, K. N., *Arch. Ophthalmol. (Chicago)*, **52**, 197-211 (1954)
114. Ivanoff, A., and Bourdy, C., *Ann. Optique Oculaire*, **3**, 70-75 (1954)
115. Ivanoff, A., and Bourdy, C., *Opt. Acta*, **1**, 192 (1955)
116. Gruber, H. E., *Am. J. Psychol.*, **67**, 411-26 (1954)
117. Weale, R. A., *Ophthalmologica*, **128**, 380-88 (1954)
118. Weale, R. A., *Brit. J. Ophthalmol.*, **38**, 248-49 (1954)
119. Robinson, E. J., *Am. J. Psychol.*, **67**, 464-74 (1954)
120. Trincker, D., *Psychol. Forsch.*, **24**, 513-41 (1954)
121. Attneave, F., *Am. J. Psychol.*, **68**, 69-82 (1955)
122. Leibowitz, H. W., Myers, N. A., and Grant, D. A., *J. Opt. Soc. Amer.*, **45**, 76-78 (1955)
123. Klemmer, E. T., *AFCRC Technical Rept. 54-54* (1954)
124. Pollack, I., and Klemmer, E. T., *AFCRC Technical Rept. 54-16* (1954)
125. Pollack, I., and Klemmer, E. T., *AFCRC Technical Rept. 54-15* (1954)
126. Eriksen, C. W., *J. Appl. Psychol.*, **39**, 73-77 (1955)
127. Brown, K. T., *Am. J. Psychol.*, **67**, 533-38 (1954)
128. Adams, O. S., *Am. J. Psychol.*, **68**, 54-68 (1955)
129. Künnapas, T. M., *Repts. Psychol. Lab., Univ. Stockholm*, No. 9, 5 pp. (1954)

130. Krauskopf, J., Duryea, R. A., and Bitterman, M. E., *Am. J. Psychol.*, **67**, 427-40 (1954)
131. Bitterman, M. E., Krauskopf, J., and Hochberg, J. E., *Am. J. Psychol.*, **67**, 205-19 (1954)
132. Adams, O. S., Fitts, P. M., Rappaport, M., and Weinstein, M., *J. Exptl. Psychol.*, **48**, 81-88 (1954)
133. Arnoult, M. D., *J. Exptl. Psychol.*, **47**, 323-28 (1954)
134. Langdon, J., *Quart. J. Exptl. Psychol.*, **7**, 19-27 (1955)
135. Langdon, J., *Quart. J. Exptl. Psychol.*, **7**, 28-36 (1955)
136. Krauskopf, J., *Am. J. Psychol.*, **67**, 684-90 (1954)
137. Hochberg, J. E., and Triebel, W., *Am. J. Psychol.*, **68**, 133-35 (1955)
138. Wertheimer, M., and Wertheimer, N., *Psychol. Rev.*, **61**, 279-80 (1954)
139. Wertheimer, M., *J. Gen. Psychol.*, **51**, 291-99 (1954)
140. Marquart, D. I., *J. Gen. Psychol.*, **51**, 83-91 (1954)
141. Fiorentini, A., Jeanne, M., and Toraldo di Francia, G., *Opt. Acta*, **1**, 192-93 (1955)
142. McCollough, C., *J. Exptl. Psychol.*, **49**, 141-52 (1955)
143. Naylor, E. J., and Stanworth, A., *J. Physiol. (London)*, **124**, 543-52 (1954)
144. Miles, W. R., *J. Neurophysiol.*, **17**, 22-38 (1954)
145. Isobe, K., and Motokawa, K., *Nature*, **175**, 306-7 (1955)
146. Prentice, W. C. H., *Am. Psychol.*, **67**, 315-20 (1954)
147. Carmichael, L. C., Hogan, H. P., and Walter, A. A., *J. Exptl. Psychol.*, **15**, 73-86 (1932)
148. Attneave, F., *Psychol. Rev.*, **61**, 183-93 (1954)
149. Walls, G. L., *Am. J. Optometry*, **31**, 329-41 (1954)
150. King-Ellison, P., and Jenkins, J. J., *Am. J. Psychol.*, **67**, 700-3 (1954)
151. Miller, G. A., Bruner, J. S., and Postman, L., *J. Gen. Psychol.*, **50**, 129-39 (1954)
152. Murdock, B. B., *J. Personality*, **22**, 565-71 (1954)
153. Postman, L., and Conger, B., *Science*, **119**, 671-73 (1954)
154. Neisser, U., *J. Exptl. Psychol.*, **47**, 399-402 (1954)
155. Lysak, W., *J. Exptl. Psychol.*, **47**, 343-50 (1954)
156. Reece, M. M., *J. Abnormal Social Psychol.*, **49**, 165-72 (1954)
157. Rosen, A. C., *J. Personality*, **23**, 182-94 (1954)
158. Smith, D. E. P., and Hochberg, J. E., *J. Psychol.*, **38**, 83-87 (1954)
159. Berger, C., and Mahneke, A., *Am. J. Psychol.*, **67**, 509-12 (1954)

# TASTE AND SMELL<sup>1</sup>

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Research contributions in the chemical senses come from such diverse groups as chemists, physiologists, psychologists, food technologists, and workers in other industrial fields. Several interdisciplinary symposia have been sponsored in the last several years, not only for the purpose of discussing applied problems but to exchange basic information and concepts. An Odor Correlation Conference has appeared as a substantial volume of the *Annals of the New York Academy of Sciences* (1). Some 25 contributions under four major classes can be found in this volume: (a) the odor problem in industry and sciences, (b) the status of present knowledge of the olfactory process, (c) the status of subjective and objective measurement techniques, and (d) experimental studies in odor. A symposium on the applied psychophysics and psychometrics of taste and smell relative to the problem of the Quartermaster Corps and the food industry was sponsored by the National Research Council in October, 1954 (2). And a symposium on the Physiological Aspects of Testing Contact Chemoreception has appeared (3). At a conference during the 1954 meeting of the American Chemical Society topics ranged from the physical chemistry of taste and odor to the factors in sensitivity that underlie different taste preferences in man. These all indicate a widespread interest in the chemical senses outside the specific confines of psychology and physiology. A technology of odor and flavor is slowly taking form. Although psychologists have participated in some of this development, a great many advances have come from nonpsychologists, as for example in the development of statistical methods for the assessment of food flavors (4, 5, 6). Many of the classical problems of psychophysics are encountered and sometimes rediscovered in this context. Yet a study of this literature can be rewarding, both from the point of view of psychophysical theory and practice. Out of the conference on chemoreception held several years ago under the auspices of the Office of Naval Research have come recommendations for standardizing nomenclature (7).

A recent review (8) of the comparative physiology of the nervous system and sense organs includes a section on the chemical senses which concludes with the following statement "Chemoreception remains the most elusive of all the senses as to mechanism." The present reviewer agrees, but believes there are grounds for optimism concerning the years immediately ahead.

## TASTE

*Receptor mechanisms.*—The existence of taste buds on regions of the mouth other than the tongue has long been known, especially in the posterior

<sup>1</sup> The survey of the literature pertaining to this review was completed in May, 1955.

regions of the mouth, soft palate, larynx, etc. Their presence on the anterior roof of the mouth had been described primarily in fetal material. The existence of taste buds in the anterior hard palate in the region of the nasopalatine ducts of the rat (9) has been confirmed in the course of a systematic examination of the taste buds in the roof of the mouth. In the rat about 165 taste buds were so located, of which approximately 60 lie in the nasopalatine ducts (10). The finding of nonlingual gustatory endings in such numbers accounts for the fact that lingual denervation in the rat reduces, but does not eliminate, taste preference behavior.

The role of the peripheral nerves in the growth and development of taste buds has been subjected to further study (11). The role of still another formative agent, the gonadal hormones, is perhaps less well known. Allara (12) showed that castration in male and female rats was followed by a reduction in the number of taste buds in the vallate papillae. Injection of gonadic hormones led to a reversal of the involutional process. A behavioral study (13) utilizing the preference method showed no loss of sensitivity in castrate male and female rats to sugar, quinine, tartaric acid, and sodium chloride. These results confirm the findings of Warren & Pfaffmann (14), who tested only quinine and sodium chloride responses after castration. Of particular interest is the report by Italian workers of sex differences in the pattern of preferences in the normal animal.

The anatomy of the sensory endings in the buccal cavity of man and animals has been re-examined with a modified silver stain method in a series of studies by Japanese investigators (15 to 18). They describe plexus-like formations under the taste buds from which both intrageminal and extrageminal fibers originate. Three types of taste bud were noted, those supplied with thick and thin fibers, those with thick fibers only, and those with thin fibers only. Taste buds with no demonstrable nerve supply were also observed and were judged to be nonfunctional.

One of the most active research areas has been that of electrophysiology. Particularly striking is the evidence for a species difference in the response to different taste stimuli (19, 20). Although such differences are consistent with the fact that many biochemical processes show a species specificity, previous workers have tended to emphasize the common features in the comparative scale (21). The magnitude of the afferent neural discharge as measured by an integrator method was very similar for HCl in the rat, rabbit, and cat, while there was a striking difference in the effectiveness of NaCl. HCl and NaCl in equimolar concentrations are very nearly equally effective in the rat. For the rabbit and cat, much higher concentrations of NaCl (about 10 to 30 times higher) are required. The responses to quinine and sucrose typically are of lesser magnitude suggesting that there may be fewer quinine and sugar sensitive fibers in the chorda tympani. However, whereas the cat shows a good quinine but poor sucrose response, the rabbit is just the converse, while the rat is intermediate with approximately equal responses of small magnitude to sucrose and quinine (22).

Single fiber analysis in the rat shows that the specificity of endings to the different chemical stimuli does not fall into four classical receptor types. Rather, any one receptor may be sensitive to one or more of the basic taste stimuli. In one ending, for example, HCl, NaCl, and quinine might be effective. In another, only HCl and NaCl might stimulate, but to different degrees. In still another HCl, NaCl, and sucrose might be effective. Thus although any one fiber responds differentially to the four basic taste stimuli, it may show any one of a wide variety of patterns of sensitivity. Discrimination presumably would depend upon such patterning of the gustatory afferent input. These findings agree with and extend the early observations on the cat (23). Furthermore, they suggest a line of reasoning similar to that proposed by last year's *Annual Review* author in the area of somesthetic sensitivity (24). He emphasized that the neuroanatomical data did not support the thesis that particular cutaneous qualities are determined by particular types of morphological endings. Rather, the primary cutaneous qualities are convenient descriptive headings rather than actual entities. The same might be said for taste.

The extension of Müller's law of specific energies to cover different qualities of sensation within the different modalities equates phenomenological classes with anatomical or physiological entities. As experience and evidence in the field of physiological psychology generally accumulate, it is apparent that such one-for-one correlations of physiological with psychological terms cannot be supported. Thus the patterns of sensitivity found in the electrophysiological studies do not conform to the four basic taste categories of salt, sour, bitter, and sweet. In this connection it is of interest that the taste of one of the presumed fundamental taste stimuli, NaCl, changes from a pure salty quality to bitter in the course of adaptation in the human subject (25).

The water taste first reported by Zotterman (26) and Anderson & Zotterman (27) in frogs has been suggested as a possibility in mammals. Weak salt solutions do not taste salty although they may be distinguished from distilled water with accuracy. In a recent study (28), for example, of NaF thresholds, it was reported that the minimum concentration that could be discriminated from water fell at  $.00013 M$ , a value far below the recognition threshold for saltiness of this substance. The discrimination was attributed to a general "ionic effect." In studying 12 cats, one dog, and one pig, Liljestrand & Zotterman (29) noted that washing the tongue with distilled water led to a considerable response whereas washing with Ringers had only a slight effect. In a preparation consisting of a few fibers from the chorda tympani nerve some fibers displayed increased impulse activity after application of water but not of salt. Other strands were found that reacted to salt or glycine but not water. The authors conclude that there are specific nerve endings, most likely in all mammals, responding to water containing no electrolytes or only very small amounts thereof. Similar observations have been made by this author (22). In fact, the response to water is much the

most striking phenomenon in the chorda tympani nerve in the rabbit. Here, the response to water is especially strong and the inhibitory or quieting effect of NaCl solutions is especially notable. However, single fiber studies showed that in the rabbit, water reactivity was always associated with sensitivity to other stimuli, in particular HCl and KCl, and the response to water was influenced by the previous history of stimulation. After NaCl, the water was less effective. After acid the response was enhanced. Such effects were also present in the cat and rat, but less apparent. It would appear that the response to water in mammals does not reflect a specific sensitivity to water, but rather excitability differences toward particular ions in which sodium appears to play a particular role. Liljestrand & Zotterman also report that the water receptor fibers in mammals responded to acetic acid and that the responses to acid could not be differentiated from those after water or salt. This is contrary to the case in the frog. Whether or not specific water receptors are present in the mammal, these studies do emphasize the importance of water as well as of dissolved substances in initiating activity from the taste receptors. Unfortunately, the data on species differences were available only as an abstract or brief report when the Stockholm group reported their studies. The rat is far more sensitive to NaCl than either the cat or the rabbit. The threshold ranges for the cat found by American and Scandinavian workers appear to be in good agreement.

Landgren, Liljestrand & Zotterman (30) studied the effect of acetylcholine, drugs which inhibit cholinesterase, and drugs that antagonize acetylcholine on the taste receptors of the frog. They concluded that acetylcholine is concerned in the initiation of impulses in both the water sensitive and salt sensitive receptors in the frog. Perhaps this study bears some relation to a report on ageusia in myasthenia gravis, a disease traceable to malfunction of acetylcholine metabolism (31).

An impressive theoretical paper based on a quantitative analysis of electrophysiological data has been presented by Beidler (32). It is assumed that the gustatory reaction process obeys the mass action law. The mathematical treatment so developed yields predictions that are in good agreement with the observed values for a series of sodium salts. The values found for change in free energy are much smaller than those usually found for enzymatic reactions. Furthermore, the response to salt shows little sensitivity to temperature change between 20° to 30° C. or to pH changes. These properties point to a reaction involving physical rather than chemical forces. The process may be similar to that which occurs in ion binding by proteins or natural polyelectrolytes in which ions are loosely bound to the cell surface. This theory and analysis have been developed so far only for the behavior of electrolytes. Such analyses hold great promise for the advancement of our insights into the basic stimulating mechanisms in the sense of taste.

The so-called critical fusion frequency of taste has been subjected to further study. Two recent attempts to examine this phenomenon did not report systematic data because gustatory flicker could not be obtained with an



intermittent square wave electrical stimulus of varying frequency (33, 34). Subjects reported a variety of complex sensations of cold, sour, and bitter as well as pain. Any interruption of sensation appeared to have a tactile quality. Pierrel (35) found that cathodal square waves from 20 to 1,000 per second stimulation yielded the complex of qualities noted above, but that anodal stimulation elicited a relatively good, steady metallic sour when it appeared at threshold. With further increase in stimulus intensity the sensation increased until an intermittence or pulsation was superimposed upon the taste. On the tongue, thresholds for taste were always lower than those for pulsation. Both values tended to rise with frequency. When the same electrical stimulus was applied to the mucous of the inner lip surface, only pulsation was reported. The frequency intensity functions for pulsation from the lip and from the tongue were very similar.

The pulsation phenomenon was the only type of interrupted or flicker type experience reported. If critical fusion frequency of taste actually depends upon the pulse threshold process, then inferences about the receptor mechanisms of taste receptor process cannot be drawn from such data. The failure of all three recent attempts to confirm the original Allen-Weinberg result (36) must certainly cast serious doubt on the validity of the so-called critical fusion frequency of taste.

The validity of another widely quoted concept in the chemical senses, that of the common chemical sense, has been the subject of critical study. That the mucous membranes of the mouth, nose, eyes, and other structures are responsive to irritants is beyond question. Chemical irritants appear to have specific effects, for as Moncrieff has pointed out (37), they may cause crying, sneezing, or irritation of the skin itself. On the other hand, the only evidence that appears to dissociate chemical sensitivity from pain or from free nerve ending responsiveness is from experiments on lower aquatic organisms. These have been criticized for one reason or another. Jones attempted to dissociate pain sensitivity of the lip from chemical responsiveness by comparing the thresholds for a series of piperidine solutions with pain by needle prick and by electric shock. Cocain raised both the pain and chemical thresholds in five subjects. No rise in chemical sense occurred in two instances. No changes occurred for electrical thresholds after cocaineization. Since the level of cocaineization was not quantitatively controlled, these findings cannot be considered as conclusive, especially since two of the five subjects did show an apparent dissociation of the two responses (38).

A brief note (39) gives data from different workers for the heteroqualitative intensity matches for sucrose and NaCl solutions. Analysis of the extent to which absolute judgments of intensity can be made for taste solutions shows that only three steps of intensity can be judged with 100 per cent accuracy (40). Still another study (41) of monosodium glutamate failed to find the widely advertised enhancing effect on taste sensitivity.

In invertebrate forms an attempt was made to determine whether stimuli in vapor or aqueous phase could be detected by two different modalities

equivalent to taste and smell in man. Only quantitative differences were found in thresholds of stimuli applied to the mouth parts compared to the antennae. It was concluded that no differences in modality existed (42). Temperature of ambient air and solution was found to influence the acceptance thresholds for sucrose solutions by the flesh fly. A minimum value occurred at  $28^{\circ} \pm 1^{\circ} \text{C}$ . (43). This finding is not readily interpretable in terms of physico-chemical mechanism. DDT [1,1,1-trichloro-2,2-bis(*p*-chlorophenyl)ethane] was found to lower the sucrose acceptance thresholds about ninefold in DDT sensitive but not in DDT insensitive flies. Salt or alcohol rejection thresholds were not affected at all. These findings are in keeping with the view that at least two classes of chemoreceptor occur in the organism studied (44). Summation and inhibition following the stimulation of tarsal chemoreceptors in the blowfly have been demonstrated by the ingenious method of bilateral stimulation of contralateral legs as compared with unilateral stimulation with mixtures in one- and two-legged preparations. The prevention of proboscis extension to water or sucrose by unacceptable compounds appears to be predominantly a central process (45).

*Central neural processes.*—The study of the central neural pathways for the sense of taste is complicated by several technical difficulties. The sensory field for taste of the tongue and mouth area is shared with somesthesia. The peripheral nerve supply is distributed through several cranial nerves. The evoked potential method which has proved so fruitful in the study of the other sensory systems usually requires a synchronized volley of impulses for detection at the cortical level. The taste nerve discharge is typically an asynchronous volley of impulses. Finally the taste system, at least at the periphery, consists of fibers of smaller diameter and potential than those in the tactile system. Some of these difficulties can be minimized by a combination of techniques. The chorda tympani nerve, which is largely concerned with taste, can be stimulated by an electric shock to send a synchronized volley into the central nervous system. This method was used by Patton & Amassian (46) to identify a small region on the orbital surface of the cat's cortex. However, since the chorda tympani contains some tactile and perhaps temperature fibers, the interpretation of such evoked potentials should be made with caution. Benjamin & Pfaffmann (47) applied the same method in the rat to locate a chorda tympani and glossopharyngeal nerve region approximately 2 sq. mm. in size on the orbital surface. After ablating this area, preference thresholds for quinine in a two-bottle choice method were significantly increased. These findings are in agreement with those of Gerebtzoff (48) which pointed to the general region of Bremer's masticatory area (49) of the rabbit for taste discrimination. Gerebtzoff, however, believed that the insula especially (as well as parainsular area) was involved in gustatory function. In the primate, discrimination of taste solutions is impaired when the insular and parainsular areas are removed (50). The closeness of the insula to tongue areas in the rat is such that the operative procedures in the Benjamin-Pfaffmann study might well have included both structures. These

experiments are not critical in separating insular from somesthetic tongue regions as taste areas.

In a second paper Benjamin (51) has shown that cortical ablation can lead to different results when different methods of testing taste discrimination are employed. One procedure was the usual two-bottle 24 hr. ad libitum choice method whereas the second was a one-bottle 1 hr. test method following 16 hr. deprivation. After ablation of the composite nerve area, thresholds were elevated in the two-bottle, not in the one-bottle test. Benjamin goes on to hypothesize that the difference in the two tests is determined by the motivational or deprivation level. In the one-bottle method, thresholds for the same animal tend to be higher than in the two-bottle method.

Benjamin's findings are especially important for they emphasize that different behavioral techniques for measuring sensorially determined behavior do not necessarily tap the same psychophysiological functions. Discrimination is not a unitary process. Thus it is not correct to say that removal of a particular cortical area makes the animal taste blind. Rather the operation renders the animal less efficient in making the discrimination under conditions of low drive, ad libitum choice. But quinine solutions can still be discriminated in higher concentrations. In the one-bottle deprivation situation, the behavior is under the control of other variables such that cortical taste mechanisms do not significantly contribute to the control of behavior.

*Behavior processes.*—The role of gustatory stimulation in specific hunger behavior continues to be a problem of active interest. The well known rise in salt preference following adrenalectomy has been further documented (52, 53), but the absence of a preference threshold change in hypertensive rats does not agree with their reported aversion for suprathreshold concentrations. On a synthetic sodium free diet both normal and hypertensive rats showed higher thresholds than those animals on a Purina lab chow diet (54) and thus failed to increase their salt intake. Tribe (55) has emphasized the failure of animals to select an adequately nutritious diet. Forced exercise did not lead to an increased intake (55a). In a careful field study (55b) of cattle grazing on phosphorus deficient pasturage, it was found that although osteophagia was present, animals failed to select phosphorus rich meal when it was made available over a period of several months. Barnett (55c) has emphasized that experiential factors are important in determining the food selection of wild as well as albino rats.

Harriman & MacLeod (56) utilized a shock avoidance conditioning method to study the NaCl thresholds of normal and adrenalectomized rats. They confirmed previous findings of no difference in sensory acuity between the two groups. Their results, however, are noteworthy because of the extremely low threshold values obtained (from .000025 per cent to .002 per cent). These are considerably lower than those found by Carr (57) with a similar technique and lower than other preference or electrophysiological values. Although the discrepancy between the conditioning and electro-

physiological values might be attributable to the difficulty of detecting low level responses in the nerve, this explanation does not seem very probable. In the case of single nerve fibers, where the signal to noise ratio is much more favorable than in the total nerve, single unit thresholds lie at or above the value for the total nerve. Perhaps the stimulating effect of water emphasized by Zotterman might be relevant here in spite of the fact that the existence of specific water receptors in mammals has not been firmly established. Further research on the effect of very dilute solutions is called for in both discrimination as well as physiological studies.

In the rabbit there is evidence that the discrimination of NaCl solutions in a two-bottle preference situation takes place in the concentration range where salt is less stimulating than water (58). The preference for salt in the rabbit is much like that shown by the rat. The preference begins at about .02 *M* with a peak preference at .1 *M*. In this range the electrophysiological response to salt is primarily a depression of activity following the initial transient. Water on the other hand gives a marked response that may continue for some time. Thus a reduction in neural discharge rather than increase appears to serve as the cue for salt ingestion.

In the majority of behavior studies some measure of drinking behavior serves as an index of either taste sensitivity or preference. The factor of water balance thus is added to that of the specific response to the solute. It is of particular interest that Adolph *et al.* (59) found only two factors that enhanced drinking, the addition of diverse substances in dilute solution (especially NaCl) and experimental diabetes insipidus following lesions of the neurohypophysis. Factors that inhibit drinking are more common. Since the increase in drinking of weak salt solutions is apparent in the first 15 min., Adolph concludes that the taste dictates how much will be ingested. A dilute solution is interpreted somehow to require a greater ingestion, presumably for the purpose of restoring water balance. If water is to be gained from a solution, the normal amount of water is needed plus an extra amount for excreting the solute. Solutions that are refused appear to be those that cannot be excreted without the loss of body water. Richter & Mosier (60) have shown that rats are capable of ingesting large quantities of sodium chloride provided they are permitted to ingest sufficiently large quantities of water. No pathological changes were noted over a period of 2 to 3 months. This is in contrast to the hypertension and other pathological effects produced by high salt intake without extra water. The physiological mechanisms activated by the overload can adapt only partially to the excess salt without extra water (61, 62, 63).

Le Magnen (64, 65, 66) has shown that water taken by mouth reduces subsequent drinking of water to a greater degree than does the same amount of water administered by stomach tube. The subsequent preference for water and rejection of hypertonic solutions after tubing with 2 per cent (hypertonic) NaCl was less marked than when tubing was combined with taste stimulation by means of cotton swabs moistened with the same salt solution.

In addition, tube feeding with solutions osmotically equivalent to the salt solutions did not have the same influence as salt on the choice of water, isotonic and hypertonic salt solutions. The ionic as well as osmotic effects are important. Le Magnen stresses two phases in the control of the behavior, one a short term effect in which taste stimulation is particularly important and a second long term process in which physiological adjustments in "hydro-mineral" balance take place (66a).

O'Kelly (67) and Stellar *et al.* (68) similarly have shown that preloads of hypertonic salt solution enhance drinking of water and hypotonic salt solutions and depress that of hypertonic solutions. When the gastric factor is eliminated by means of an esophageal fistula, rats continued to show the typical preference-aversion behavior toward NaCl solutions.

Injection of insulin and caloric deficiency enhance the intake of sugar or saccharin but not of NaCl solutions (69, 70, 71). The concentrations of saccharin and sugar that were about equally preferred on an ad libitum feeding schedule are no longer equal after 45 hr. of deprivation, especially following repeated tests. Sugar is much preferred. The animal learns to respond differentially to the taste stimuli on the basis of the post ingestion alimentary effect. The possibility of a direct relation between blood sugar level and taste sensitivity was studied in diabetic patients (71a). The tendency for poorer sensitivity appeared to be general for the four basic tastes and not specific to sugar. That drinking of sugar solutions can be influenced by the state of dehydration is shown by McCleary (72) who not only studied the effects of stomach tubing but of injecting salt solutions directly into the blood stream. Here is clear evidence of a dehydration factor.

Young & Greene (73) have apparently dissociated some of these factors with different methods of testing the preference for sugars. The typical preference aversion curve with an optimum preference at .25 per cent saccharin was obtained in another experiment (74) when six containers were presented simultaneously. In brief exposure tests with thirsty animals, the optimum fell below .075 per cent. In a bar pressing situation Guttman (75) found that sucrose was more reinforcing than glucose of equimolar concentration as judged by the number of responses. The ratio of concentration of the two sugars approximated the values found in man for equal sweetness. From these results it was concluded that the reinforcing effect of stimuli is proportional to the degree of sensory effect. These results are in good agreement with Hagstrom & Pfaffmann's (76) electrophysiological data which show that in the rat sucrose produced an afferent nerve discharge of greater magnitude than did glucose of equimolar concentration. Both sets of results show a different order of effectiveness than did the two-bottle preference method (77).

Thus we see that differences in method of testing the reaction toward solutions with both taste stimulating properties as well as general and specific physiological effects may yield quite different conclusions. It is misleading to include the behavior in all these different situations under the single head-

ing of preference or acceptability. As in the case of the studies of central nervous system function different results may be obtained with different methods of studying behavior. These differences have a significance beyond that of mere methodology. They provide a clue not only as to the factors of significance underlying the behavior, but of the manner in which the behavior is organized.

#### SMELL

*Method.*—Methodology in olfaction continues to be a major concern. The blast injection method that seemed to hold such promise because of its simplicity has been entirely discarded by Wenzel (78). She has designed a new apparatus in which a continuous stream of purified air is blown into a Plexiglas chamber large enough to enclose the subject's head. Odors in known amount can be added to the flow system so that concentrations can be specified in molecules per unit volume of air. The subject sniffs the air in the chamber. Another technique (79) which borrows something from the blast method utilizes a motor driven syringe to draw various fractions from an odorizing bottle. The substance can then be diluted by filling the remainder of the syringe with pure air. A steady blast at constant pressure and rate of flow is directed into the subject's nose. Variations in concentration of odorant are achieved by varying the proportion of odorized to pure air. The molar concentration of the odor stimulus can be calculated. The subject also is enclosed in a small chamber supplied with purified air. Other workers, however, continue to use the Elsberg method both in clinical (80) and experimental studies (81). Acetylcholine-like substances, menthol, and strychnine were found to reduce blast injection thresholds in man. Saline solutions, the solvent, only raised thresholds. An olfactory chamber for observing the chemotropic responses of insects or other small organisms has been described (82).

A scale for measuring suprathreshold olfactory intensity is provided by a geometric dilution series (factor of twofold reduction) of *n*-heptanol in benzyl benzoate, a relatively odorless organic solvent. Other odorants can be matched against this series for intensity of odor in spite of difference in odor quality. Good reproducibility in judgments is found (83). The judgment of suprathreshold intensities by matching is said to be superior to threshold judgment. Subjects may report strong imagined differences between weak olfactory stimuli when no physical differences exist (84). Individual differences in the ability to smell solutions of potassium cyanide observed in men and women were attributed to a sex linked recessive characteristic (85). Increased olfactory sensitivity was reported in subjects during an attack of nausea (86).

*Neural mechanisms.*—Allison (87) has made important and thorough studies of the anatomy of the olfactory bulb and its central connections. Transection of the olfactory tract or anterior commissure or both (in rabbits and rats) is followed by degenerative changes that indicate the existence of



two relatively independent pathways relaying impulses from the glomeruli. One is the mitral cell olfactory tract system, the other a tufted cell anterior commissure system. The great majority, if not all, of the fibers in the olfactory tract are centrally directed while in the anterior limb of the anterior commissure fibers pass both to and from the bulb. It is likely that afferent fibers to the olfactory bulb arise from the basal areas of the hemisphere on the same side as well as from the opposite olfactory bulb. The vertebrate olfactory system appears to be remarkably constant in morphology throughout the vertebrates (88). Evidence is summarized which makes it unlikely that the septum, entorhinal area, hippocampal formation, or cingular gyrus plays a significant role in olfaction. These concepts are confirmed in a study (89) of a marsupial brain. Study of the secondary olfactory areas in the human brain is consistent with these conclusions, showing that much of the classical rhinencephalon does not receive direct connections from the olfactory bulb (90).

Histological studies of the olfactory bulb in man by Ogasawara (91), using a modified silver technique, led to conclusions that are markedly at variance with the usually accepted views. For example, mitral cells (renamed bulbous cells by this worker) are said to give rise to the afferent fibers directly so that there is no discontinuity between the sensory endings in the mucosa and cell bodies of the bulb.

It is probable that the general interest in the anatomy of the olfactory system (92) in part reflects a renewed interest following Adrian's electrophysiological studies of the olfactory system (93, 94). Wave-like oscillation of 30 to 50 c.p.s. is a particularly striking feature of the olfactory bulb. Olfactory stimulation may initiate long or short bursts of such activity, depending upon the level of anesthesia and intensity of the stimulus. Although this rhythmic activity was originally attributed to the neuronal network in the bulb, there is evidence now that such activity may arise peripherally. By recording from the unmyelinated nerve bundles from the vomeronasal organ, Adrian found waves very much like those in the accessory olfactory bulb (95, 96). Even more recently Adrian (97) has recorded smooth sinewave-like oscillatory waves from the olfactory mucosa directly following odor stimulation. The frequency range was from 30 to 60 per sec. with an amplitude of .05 to .1 mv. This is a most interesting and striking phenomenon. One is reminded of the electrical activity in other sense organs and of the possibility of examining more closely the activity of the sensory surface itself under the influence of odorous stimuli. Activity of the same type in the human olfactory bulb in schizophrenic patients was recorded with implanted depth electrodes (98). The results so far are preliminary in nature.

A second type of activity may be recorded from the bulb when wire needle electrodes are inserted into the deeper layers of the bulb. This appears to be spike activity from mitral cells or their axons. This activity shows differential characteristics in relation to odor. Water-soluble odorants tend to activate the anterior bulb in the rabbit whereas fat-soluble stimuli tend to



physiological values might be attributable to the difficulty of detecting low level responses in the nerve, this explanation does not seem very probable. In the case of single nerve fibers, where the signal to noise ratio is much more favorable than in the total nerve, single unit thresholds lie at or above the value for the total nerve. Perhaps the stimulating effect of water emphasized by Zotterman might be relevant here in spite of the fact that the existence of specific water receptors in mammals has not been firmly established. Further research on the effect of very dilute solutions is called for in both discrimination as well as physiological studies.

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Injection of insulin and caloric deficiency enhance the intake of sugar or saccharin but not of NaCl solutions (69, 70, 71). The concentrations of saccharin and sugar that were about equally preferred on an ad libitum feeding schedule are no longer equal after 45 hr. of deprivation, especially following repeated tests. Sugar is much preferred. The animal learns to respond differentially to the taste stimuli on the basis of the post ingestion alimentary effect. The possibility of a direct relation between blood sugar level and taste sensitivity was studied in diabetic patients (71a). The tendency for poorer sensitivity appeared to be general for the four basic tastes and not specific to sugar. That drinking of sugar solutions can be influenced by the state of dehydration is shown by McCleary (72) who not only studied the effects of stomach tubing but of injecting salt solutions directly into the blood stream. Here is clear evidence of a dehydration factor.

Young & Greene (73) have apparently dissociated some of these factors with different methods of testing the preference for sugars. The typical preference aversion curve with an optimum preference at .25 per cent saccharin was obtained in another experiment (74) when six containers were presented simultaneously. In brief exposure tests with thirsty animals, the optimum fell below .075 per cent. In a bar pressing situation Guttman (75) found that sucrose was more reinforcing than glucose of equimolar concentration as judged by the number of responses. The ratio of concentration of the two sugars approximated the values found in man for equal sweetness. From these results it was concluded that the reinforcing effect of stimuli is proportional to the degree of sensory effect. These results are in good agreement with Hagstrom & Pfaffmann's (76) electrophysiological data which show that in the rat sucrose produced an afferent nerve discharge of greater magnitude than did glucose of equimolar concentration. Both sets of results show a different order of effectiveness than did the two-bottle preference method (77).

Thus we see that differences in method of testing the reaction toward solutions with both taste stimulating properties as well as general and specific physiological effects may yield quite different conclusions. It is misleading to include the behavior in all these different situations under the single head-

ing of preference or acceptability. As in the case of the studies of central nervous system function different results may be obtained with different methods of studying behavior. These differences have a significance beyond that of mere methodology. They provide a clue not only as to the factors of significance underlying the behavior, but of the manner in which the behavior is organized.

#### SMELL

*Method.*—Methodology in olfaction continues to be a major concern. The blast injection method that seemed to hold such promise because of its simplicity has been entirely discarded by Wenzel (78). She has designed a new apparatus in which a continuous stream of purified air is blown into a Plexiglas chamber large enough to enclose the subject's head. Odors in known amount can be added to the flow system so that concentrations can be specified in molecules per unit volume of air. The subject sniffs the air in the chamber. Another technique (79) which borrows something from the blast method utilizes a motor driven syringe to draw various fractions from an odorizing bottle. The substance can then be diluted by filling the remainder of the syringe with pure air. A steady blast at constant pressure and rate of flow is directed into the subject's nose. Variations in concentration of odorant are achieved by varying the proportion of odorized to pure air. The molar concentration of the odor stimulus can be calculated. The subject also is enclosed in a small chamber supplied with purified air. Other workers, however, continue to use the Elsberg method both in clinical (80) and experimental studies (81). Acetylcholine-like substances, menthol, and strychnine were found to reduce blast injection thresholds in man. Saline solutions, the solvent, only raised thresholds. An olfactory chamber for observing the chemotropic responses of insects or other small organisms has been described (82).

A scale for measuring suprathreshold olfactory intensity is provided by a geometric dilution series (factor of twofold reduction) of *n*-heptanol in benzyl benzoate, a relatively odorless organic solvent. Other odorants can be matched against this series for intensity of odor in spite of difference in odor quality. Good reproducibility in judgments is found (83). The judgment of suprathreshold intensities by matching is said to be superior to threshold judgment. Subjects may report strong imagined differences between weak olfactory stimuli when no physical differences exist (84). Individual differences in the ability to smell solutions of potassium cyanide observed in men and women were attributed to a sex linked recessive characteristic (85). Increased olfactory sensitivity was reported in subjects during an attack of nausea (86).

*Neural mechanisms.*—Allison (87) has made important and thorough studies of the anatomy of the olfactory bulb and its central connections. Transection of the olfactory tract or anterior commissure or both (in rabbits and rats) is followed by degenerative changes that indicate the existence of

two relatively independent pathways relaying impulses from the glomeruli. One is the mitral cell olfactory tract system, the other a tufted cell anterior commissure system. The great majority, if not all, of the fibers in the olfactory tract are centrally directed while in the anterior limb of the anterior commissure fibers pass both to and from the bulb. It is likely that afferent fibers to the olfactory bulb arise from the basal areas of the hemisphere on the same side as well as from the opposite olfactory bulb. The vertebrate olfactory system appears to be remarkably constant in morphology throughout the vertebrates (88). Evidence is summarized which makes it unlikely that the septum, entorhinal area, hippocampal formation, or cingular gyrus plays a significant role in olfaction. These concepts are confirmed in a study (89) of a marsupial brain. Study of the secondary olfactory areas in the human brain is consistent with these conclusions, showing that much of the classical rhinencephalon does not receive direct connections from the olfactory bulb (90).

Histological studies of the olfactory bulb in man by Ogasawara (91), using a modified silver technique, led to conclusions that are markedly at variance with the usually accepted views. For example, mitral cells (renamed bulbus cells by this worker) are said to give rise to the afferent fibers directly so that there is no discontinuity between the sensory endings in the mucosa and cell bodies of the bulb.

It is probable that the general interest in the anatomy of the olfactory system (92) in part reflects a renewed interest following Adrian's electrophysiological studies of the olfactory system (93, 94). Wave-like oscillation of 30 to 50 c.p.s. is a particularly striking feature of the olfactory bulb. Olfactory stimulation may initiate long or short bursts of such activity, depending upon the level of anesthesia and intensity of the stimulus. Although this rhythmic activity was originally attributed to the neuronal network in the bulb, there is evidence now that such activity may arise peripherally. By recording from the unmyelinated nerve bundles from the vomeronasal organ, Adrian found waves very much like those in the accessory olfactory bulb (95, 96). Even more recently Adrian (97) has recorded smooth sinewave-like oscillatory waves from the olfactory mucosa directly following odor stimulation. The frequency range was from 30 to 60 per sec. with an amplitude of .05 to .1 mv. This is a most interesting and striking phenomenon. One is reminded of the electrical activity in other sense organs and of the possibility of examining more closely the activity of the sensory surface itself under the influence of odorous stimuli. Activity of the same type in the human olfactory bulb in schizophrenic patients was recorded with implanted depth electrodes (98). The results so far are preliminary in nature.

A second type of activity may be recorded from the bulb when wire needle electrodes are inserted into the deeper layers of the bulb. This appears to be spike activity from mitral cells or their axons. This activity shows differential characteristics in relation to odor. Water-soluble odorants tend to activate the anterior bulb in the rabbit whereas fat-soluble stimuli tend to

activate the posterior regions. Individual spikes may be identified especially in the mid bulb area which shows a differential response to different odorants. Thus there is a regional difference in the pattern of activity aroused by different odorants as well as differences in detail within a particular locus (93).

Walsh (99) has utilized micropipette electrodes to study the activity of the individual units. He has found at least three groups of neurones: those that discharge spontaneously and irregularly, those that fire intermittently in bursts during inhalation, and a third group that was activated by olfactory stimulation. The first two types were not so activated. Although only a small number of odor reactive elements were found, odor specificity was seen in this group.

The relation of olfactory stimulation to activity in the secondary olfactory system has been followed in the "cerveau isole" (100). The customary 30 to 35 per sec. waves were recorded from the bulb after amyl acetate stimulation. At the same time an increase in voltage and frequency was observed from the amygdala. Hippocampal activity during olfactory stimulation also was faster but far less regular. Activity in the pyriform cortex was quite similar to that in the amygdala. The relation of olfactory stimulation to arousal or activation of the brain mechanisms has been a topic of interest especially to the Italian workers (101, 102, 103). Activity in the olfactory bulb can be influenced by low frequency stimulation of the thalamus in the form of recruiting response. These responses are eliminated by severing the connection of the bulb with the brain. On the other hand the waves induced by olfactory stimulation are not affected. Bulbo-reticular stimulation can block the thalamic recruitment but not the peripherally induced waves. Here is evidence that the olfactory bulb is not only a primary receiving organ from the olfactory mucosa but that it is a structure that can be activated by other neural centers. Synchronization may be initiated peripherally as well as centrally although the two are not equivalent.

The functions of the hippocampus appear to be important in relation to the arousal of the whole neocortex generally. The characteristic large slow waves in this structure were often correlated with neo-cortical arousal or desynchronization (104). Olfactory stimulation does not appear to be different from the stimulation of other sensory modalities in activating such a response.

*Behavioral relations.*—The widespread connections of the rhinencephalon have led to speculations in the past that this structure along with the olfactory system has particular significance for the functional control of the nervous system and hence behavior. Recent anatomical and physiological findings all contraindicate the special role of olfactory stimulation in this regard. Behavioral findings also have failed to show that olfactory stimulation has an unusual significance in animals beyond the ability to utilize olfactory cues as learnable cues. Odor discriminations of great subtlety have been demonstrated in careful field trials of retrieving and tracking by dogs (105). The significance of certain sexual odors in animal behavior has been largely

a matter of conjecture. Experimental (106) studies do not provide striking evidence of their unique importance over other sense qualities although their significance has been emphasized anew in recent studies by Le Magnen (107). The strong inhibitory reflex effects of odorous substances can be largely attributed to the trigeminal effect of certain odors (108), although certain odorants have been shown to have a deterrent effect on eating and hoarding behavior in wild rats (109). Olfactory stimuli in neurotic behavior patterns do not possess remarkably different properties from stimuli in other modalities (110). Monkeys are not particularly responsive to odors until they have been utilized as conditioned stimuli in a neurosis-producing situation. In the recovery retraining procedure olfactory aversions continued for about three months after monkeys had nearly recovered from their phobic responses to loud noises or sudden lights. Cats on the other hand appear to be more reactive to olfactory stimuli than do monkeys in the same test situation as well as after training.

The behavioral significance of odorous stimuli is more apparent in invertebrate species. When an extract of the naturally occurring sexual attractant produced by the female roach was prepared, males responded to squares of paper impregnated with extract by specific sexual responses of which one component is wing raising or fluttering. This response was used as the criterion response with a group of males. A plot of the percentage of animals showing the response against log concentration yielded a straight line (111). The method developed for these studies was sufficiently reliable to permit its use as a bio-assay method (112). In honeybees odor appears to play a role in the recognition of friend and foe (113). Bees were found to be attracted to the body scent left behind on a glass tube of the test apparatus even though they had lighted only momentarily and had not exposed their scent glands. In contrast to earlier findings, it was found that honeybees do possess a greater olfactory sensitivity than man. Odor sensitivity can be reduced by removal of the antennae. The reduction in sensitivity appears to be proportional to the number of intact sense organs remaining on the antennal segments.

The distribution of thresholds to aldehydes for both acceptance and rejection by blowflies is normal with respect to the logarithm of concentration in the population tested (114). There is a progressive decrease in threshold in molar concentration values as the chain length of the molecule increases. When expressed as activities, however, most members of the series are equally stimulating. This resembles an earlier finding with normal aliphatic alcohols (115). Similar relations hold in studies of narcotic and toxic action. These relations may be of general significance for the mechanism of olfactory stimulation.

The efforts to apply electrophysiological methods to the study of insect chemoreception has not proved dramatically successful although progress in that direction is being made. Tactile responses can be observed and the enhancing effect of DDT on the discharges to such agents as toluene has been



recorded (44, 116). Thus far, however, behavioral methods have been the more productive in studying invertebrates.

*Theory.*—The search for some physical property that might be correlated directly with odor quality and odor thresholds continues. One recent note calls attention to an error in computing threshold values in molecular terms to be found in the International Critical Tables (117). Moncrieff (118) has studied the adsorption properties of a number of odorants with five different adsorption columns. These experiments were designed on the hypothesis that the odor of a substance depends upon its adsorption characteristics. Different odors were forced through each of the columns by means of a blower with an adjustable flow rate. The rate was adjusted until a just recognizable odor could be detected at the exit nosepiece. A quantity, the critical contact time, was computed from the height of adsorbent in the column, cross sectional area of the tube and rate of air flow. The differing contact times could be categorized into 10 different classes from low to high values, for each of the adsorbents. Thus each odorant could be characterized by five numbers. For example, amyl alcohol was specified as 2 1 5 1 9 to represent the five respective adsorption times. This is a strictly objective measurement except for the olfactory endpoint in the determination. When a similar method was compared with purely physical measures of adsorption in a copper chlorophyllin system there was good agreement (119). Moncrieff found that substances with different odors behaved differently towards the adsorbents whereas similar odors behaved similarly. A comparison of the adsorption of compounds of a very similar odor but with unlike constitution gave similar adsorption characteristics. These were not obviously related to chemical constitution. The notion of a relation of odor to the Raman shift has been revived, this time with emphasis on the shorter wavelengths (121). However, this formulation has been criticized on theoretical and experimental grounds (122, 123).

Davies & Taylor (120) used a biological system on the assumption that olfactory stimulation leads to penetration of the olfactory cell membranes. They studied the activity of odorants in accelerating the process of hemolysis of red blood cells. A plot of the log of accelerating power against log olfactory thresholds shows a direct relation between the two. Weak odorants possessed a low accelerating power. These workers believe that the red blood cell provides a good model of the olfactory mucosa and that their data support a theory of penetration of the sense cells by the olfactory stimulus.

Mullins (124) has examined three homologous series in man (*n*-paraffins, *n*-alcohols, and *n*-aldehydes). Thresholds were lowest for the 4 to 5 carbon substances and higher for smaller or larger numbers of carbon atoms. He goes on to say that some of the phenomena of olfaction are understandable if the data are analyzed with respect to two molecular parameters, cohesive energy density defined as the energy of vaporization of liquid per unit volume and molecular shape. The latter has been re-emphasized in a recent note (125).



Two other contributions emphasize properties of the receptor as the basis for a theory of stimulation. One provides a biochemical analysis of the lipides of the olfactory mucosa with particular concern for the role of the yellow pigment (126). The importance of enzymes in odor stimulation has been stressed with the suggestion that the stimulant is adsorbed upon enzymes of the surfaces of the sensory cell (127).

There is thus a continuation of the theory-spinning upon which a recent reviewer comments (128). However, there is an increasing tendency to provide some systematic data upon which to base theoretical formulations. Too often in the past, theories have been proposed on the basis of hunches or occasional observations. Usually the attempt has been made to find the single or essential physical parameter that determines odor property. Because of the diversity of physical-chemical relations that have already been shown to exist in biological systems with respect to chemical reactions, it seems unlikely to this reviewer that the chemical senses of either taste or smell will be found to depend on a single general stimulus dimension in a manner equivalent to the case of vision and hearing. Chemical processes are rarely explicable in terms of a single parameter. There is less likelihood that this will be the case in the more complex biological systems.

## LITERATURE CITED

1. *Ann. N. Y. Acad. Sci.*, **58**, 13-260 (1954)
2. *Food Acceptance Testing Methodology Series III, Surveys of Progress on Military Subsistence Problems* (Quartermaster Food and Container Institute, 115 pp., 1954)
3. Johnston, J., Wiswesser, W. J., Hodgson, E. S., and Elder, L. W., *Virginia J. Sci.* **6**, 14-38 (1955)
4. Bradley, R. A., *Biometrics*, **9**, 22-35 (1953)
5. Hopkins, J. W., *Biometrics*, **9**, 1-21 (1953)
6. Mason, D. D., and Koch, E. J., *Biometrics*, **9**, 39-46 (1953)
7. Pfaffmann, C., Young, P. T., Dethier, V. G., Richter, C. P., and Stellar, E., *J. Comp. Physiol. Psychol.*, **47**, 93-96 (1954)
8. Prosser, C. L., *Ann. Rev. Physiol.*, **16**, 103-24 (1954)
9. Pfaffmann, C., *J. Comp. Physiol. Psychol.*, **45**, 393-400 (1952)
10. Kaplick, M., *Z. Zellforsch. u. mikroskop. Anat.*, **38**, 571-90 (1953)
11. Kamrin, R. P., and Singer, M., *Am. J. Physiol.*, **174**, 146-48 (1953)
12. Allara, E. *Riv. biol.*, **44**, 209-29 (1952)
13. Rowinski, Di P., and Manunta, G., *Arch. fisiol.*, **53**, 117-30 (1953)
14. Warren, R., and Pfaffmann, C. (Unpublished data)
15. Ohgaki, M., and Hotta, K., *Tôhoku J. Exptl. Med.*, **57**, 375-78 (1953)
16. Okano, S., *Tôhoku J. Exptl. Med.*, **57**, 164-79 (1953)
17. Koizumi, H., *Tôhoku J. Exptl. Med.*, **58**, 211-15 (1953)
18. Abe, Y., Endo, N., and Goto, M., *Tôhoku J. Exptl. Med.*, **60**, 129-34 (1954)
19. Beidler, L. M., *Sci. Monthly*, **75**, 343-49 (1952)
20. Pfaffmann, C., *Science*, **117**, 470, (1953)
21. Frings, H., *J. Comp. Physiol. Psychol.*, **41**, 25-34 (1948)
22. Pfaffmann, C., *J. Neurophysiol.* (In press)

23. Pfaffmann, C., *J. Cellular Comp. Physiol.*, **17**, 243-58 (1941)
24. Weddell, G., *Ann. Rev. Psychol.*, **6**, 119-36 (1955)
25. Bujas, Z., *Acta Inst. psychol. Univ. Zagreb.*, No. 17, 10 pp. (1953)
26. Zotterman, Y., *Acta Physiol. Scand.*, **18**, 181-89 (1949)
27. Anderson, B., and Zotterman, Y., *Acta Physiol. Scand.*, **20**, 95-100 (1950)
28. Cox, G. J., and Nathans, J. W., *J. Appl. Physiol.*, **5**, 395-98 (1953)
29. Liljestrand, G., and Zotterman, Y., *Acta Physiol. Scand.*, **32**, 291-303 (1954)
30. Landgren, S., Liljestrand, G., and Zotterman, Y., *Acta Physiol. Scand.*, **30**, 105-14 (1954)
31. Laterza, A., and Moreno, M., *Riv. neurol., Torino*, **23**, 338 (1953)
32. Beidler, L. M., *J. Gen. Physiol.*, **38**, 133-39 (1954)
33. Jones, M. H., and Jones, F. M., *Science*, **115**, 355-56 (1952)
34. Ross, S., and Versace, J., *Am. J. Psychol.*, **66**, 496-97 (1953)
35. Pierrel, R., *J. Exptl. Psychol.*, **49**, 374-80 (1955)
36. Allen, F., and Weinberg, M., *Quart. J. Exptl. Physiol.*, **15**, 377-83 (1925)
37. Moncrieff, W., *The Chemical Senses* (Leonard Hill, Ltd., London, England, 538 pp., 1951)
38. Jones, M. H., *Am. J. Psychol.*, **67**, 696-99 (1954)
39. Beebe-Center, J. G., Rogers, M. S., and Atkinson, W. H., *J. Psychol.*, **39**, 371-72 (1955)
40. Beebe-Center, J. G., Rogers, M. S., and O'Connell, D. N., *J. Psychol.*, **39**, 157-60 (1955)
41. Pilgrim, F. J., Schutz, H. G., and Peryam, D. R., *Am. Psychologist*, **9**, 449 (1954)
42. Hodgson, E. S., *Biol. Bull.*, **105**, 115-27 (1953)
43. Frings, H., and Cox, B. L., *Biol. Bull.*, **107**, 360-63 (1954)
44. Smyth, T., and Roys, C. C., *Biol. Bull.*, **108**, 66-76 (1955)
45. Dethier, V. G., *Biol. Bull.*, **105**, 257-68 (1953)
46. Patton, H. D., and Amassian, V. E., *J. Neurophysiol.*, **15**, 245-50 (1952)
47. Benjamin, R. M., and Pfaffmann, C., *J. Neurophysiol.*, **18**, 56-64 (1955)
48. Gerebtzoff, M. A., *Arch. intern. physiol.*, **51**, 199-210 (1939)
49. Bremer, F., *Arch. intern. physiol.*, **21**, 308-52 (1932)
50. Bagshaw, M. H., and Pribram, K. H., *J. Neurophysiol.*, **16**, 499-508 (1953)
51. Benjamin, R. M., *J. Comp. Physiol. Psychol.*, **48**, 119-22 (1955)
52. Braun-Menendez, E., *Rev. soc. argentina biol.*, **29**, 92-103 (1953)
53. Binet, L., Dejours, P., and Moumouzas, N., *J. physiol. (Paris)*, **46**, 249-52 (1954)
54. Fregley, M. J., *Federation Proc.*, **14**, 50 (1955)
55. Tribe, D. E., *J. Physiol. (London)*, **124**, 64 (1954)
- 55a. Tribe, D. E., *Brit. J. Animal Behaviour*, **2**, 140 (1954)
- 55b. Gordon, J. G., and Tribe, D. E., *Brit. J. Animal Behaviour*, **2**, 72-74 (1954)
- 55c. Barnett, S. A., *Brit. J. Animal Behaviour*, **1**, 159 (1953)
56. Harriman, A. E., and MacLeod, R. B., *Am. J. Psychol.*, **66**, 465-71 (1953)
57. Carr, W. J., *J. Comp. Physiol. Psychol.*, **45**, 377-80 (1952)
58. Carpenter, J. A., *J. Comp. Physiol. Psychol.* (In press)
59. Adolph, E. F., Barker, J. P., and Hoy, P. A., *Am. J. Physiol.*, **178**, 538-62 (1954)
60. Richter, C. P., and Mosier, H. D., Jr., *Am. J. Physiol.*, **176**, 213-22 (1954)
61. Toussaint, C., Wolter, R., and Siblee, P., *Compt. rend. soc. biol.*, **147**, 1637-39 (1953)

62. Binet, L., Dejours, P., and Marquis, M., *Compt. rend. soc. biol.*, **147**, 1989-91 (1953)
63. Binet, L., Dejours, P., and Lacaille, A., *Compt. rend. soc. biol.*, **148**, 32-35 (1954)
64. Le Magnen, J., *Compt. rend. soc. biol.*, **147**, 614-19 (1953)
65. La Magnen, J., *Compt. rend. soc. biol.*, **147**, 619-23 (1953)
66. Le Magnen, J., *Compt. rend. soc. biol.*, **147**, 1675-77 (1953)
- 66a. Le Magnen, J., *Arch. sci. physiol.*, **8**, 265-82 (1954)
67. O'Kelly, L. I., *J. Comp. Physiol. Psychol.*, **47**, 7-13 (1954)
68. Stellar, E., Hyman, R., and Samet, S., *J. Comp. Physiol. Psychol.*, **47**, 220-26 (1954)
69. Le Magnen, J., *Compt. rend. soc. biol.*, **147**, 1753-56 (1953)
70. Le Magnen, J., *J. physiol. (Paris)*, **46**, 414-18 (1954)
71. Carper, J. W., and Polliard, F., *Am. J. Psychol.*, **66**, 479-82 (1953)
- 71a. Fabbri, F., *Arch. Ohren-, Nasen- u. Kehlkopfsheilk. ver. Z. Hals-, Nasen- u. Ohrenheilk.*, **164**, 543-46 (1954)
72. McCleary, R. A., *J. Comp. Physiol. Psychol.*, **46**, 411-21 (1953)
73. Young, P. T., and Greene, J. T., *J. Comp. Physiol. Psychol.*, **46**, 288-94 (1953)
74. Young, P. T., and Greene, J. T., *J. Comp. Physiol. Psychol.*, **46**, 295-98 (1953)
75. Guttman, N., *J. Comp. Physiol. Psychol.*, **47**, 358-61 (1954)
76. Hagstrom, E. C., and Pfaffmann, C., *Am. Psychologist*, **9**, 388 (1954)
77. Richter, C. P., and Campbell, K. H., *J. Nutrition*, **20**, 31-46 (1940)
78. Wenzel, B. M., *Science*, **121**, 802-3 (1955)
79. Jones, F. N., *Am. J. Psychol.*, **67**, 147-51 (1954)
80. Kristenson, H. K., and Zilstorff-Pedersen, K., *Acta Oto-Laryngol.*, **43**, 537-44 (1953)
81. Shouby, A. P., and Zilstorff-Pedersen, K., *Acta Physiol. Scand.*, **32**, 252-58 (1954)
82. Varley, G. E., and Edwards, R. L., *Nature*, **171**, 787 (1953)
83. Kruger, L., Feldzamen, A. N., and Miles, W. R., *Am. J. Psychol.*, **68**, 117-23 (1955)
84. Eisenson, J., Fisichelli, V. R., and Welch, L., *J. Genet. Psychol.*, **84**, 77-83 (1954)
85. Kirk, R. L., and Stenhouse, N. S., *Nature*, **171**, 698-99 (1953)
86. Smolić, N., *Acta Inst. psychol. Univ. Zagreb.*, No. 19, 6 pp. (1953)
87. Allison, A. C., *J. Comp. Neurol.*, **98**, 309-54 (1953)
88. Allison, A. C., *Biol. Revs., Cambridge Phil. Soc.*, **28**, 195-244 (1953)
89. Adey, W. R., *Brain*, **76**, 311-30 (1953)
90. Allison, A. C., *J. Anat.*, **88**(4), 481-88 (1954)
91. Ogasawara, N., *Tōhoku J. Exptl. Med.*, **59**, 357-69 (1954)
92. Negus, V. E., *Acta Oto-Laryngol.*, **44**, 13-24 (1954)
93. Adrian, E. D., *Acta Physiol. Scand.*, **29**, 5-14 (1953)
94. Adrian, E. D., *Brit. Med. J.*, **I**, 287-290 (1954)
95. Adrian, E. D., *J. Physiol. (London)*, **126**, 28P-29P (1954)
96. Adrian, E. D., *Pflügers Arch. ges. Physiol.*, **260**, 188-92 (1955)
97. Adrian, E. D., *J. Physiol. (London)*, **28**, 21P (1955)
98. Sem-Jacobsen, C. W., Petersen, M. C., Lazarte, J. A., Dodge, H. W., and Holman, C. B., *EEG J.*, **14**, 157 (1955)
99. Walsh, R. R., *Federation Proc.*, **14**, 157 (1955)
100. Gozzano, M., Ricci, G. F., and Vizioli, R., *EEG J.*, **6**, 532 (1954)
101. Arduini, A., and Moruzzi, G., *EEG J.*, **5**, 243-50 (1953)

102. Arduini, A., and Moruzzi, G., *EEG J.*, **5**, 235-42 (1953)
103. Rossi, G. F., and Steffanon, L., *Arch. fisiol.*, **52**, 468-74 (1953)
104. Green, J. D., and Arduini, A. A., *J. Neurophysiol.*, **17**, 533-57 (1954)
105. Kalmus, H., *Brit. J. Animal Behaviour*, **3**, 25-31 (1955)
106. Beach, F. A., *J. Comp. Physiol. Psychol.*, **33**, 163-206 (1942)
107. Le Magnen, J., *J. physiol. (Paris)*, **45**, 285-326 (1953)
108. Anderson, P., *Acta Physiol. Scand.*, **30**, 137-48 (1954)
109. Barnett, S. A., and Spencer, M. M., *Brit. J. Animal Behaviour*, **1**, 32-37 (1953)
110. Masserman, J. H., Pechtel, C., and Schreiner, L., *Psychosomat. Med.*, **15**, 396-404 (1953)
111. Wharton, D. R. A., Miller, G. L., and Wharton, M. L., *J. Gen. Physiol.*, **37**, 461-69 (1954)
112. Wharton, D. R. A., Miller, G. L., and Wharton, M., *J. Gen. Physiol.*, **37**, 471-81 (1954)
113. Ribbands, C. R., *Proc. Roy. Soc. (London)*, [B] **143**, 367-79 (1955)
114. Dethier, V. G., *J. Gen. Physiol.*, **37**, 743-51 (1954)
115. Dethier, V. G., and Yost, M. T., *J. Gen. Physiol.*, **35**, 823-39 (1952)
116. Boistel, J., and Coraboeuf, E., *Compt. rend. soc. biol.*, **147**, 1172-75 (1953)
117. Jones, F. N., *Science*, **118**, 333 (1953)
118. Moncrieff, R. W., *J. Physiol. (London)*, **125**, 453-65 (1954)
119. Hainer, R. M., *Science*, **119**, 609-10 (1954)
120. Davies, J. T., and Taylor, F. H., *Nature*, **174**, 693-94 (1954)
121. Wright, R. H., *Nature*, **173**, 831 (1954)
122. Hallam, H. E., *Nature*, **174**, 134 (1954)
123. Gerebtzoff, M. A., *J. physiol. (Paris)*, **45**, 247-83 (1953)
124. Mullins, L. J., *Federation Proc.*, **14**, 105 (1955)
125. Timmermans, J., *Nature*, **174**, 235 (1954)
126. Heusghem, C., and Gerebtzoff, M. A., *Compt. rend. soc. biol.*, **147**, 540-41 (1953)
127. Lauffer, P. G. I., *Proc. Sci. Sect. Toilet Goods Assoc.*, No. 21, 28-35 (1954)
128. Jones, N. F., and Jones, M. H., *J. Psychol.*, **36**, 207-41 (1953)

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